PB81-173346

Applying for a Permit to Destroy PCB (Polychlorinated Biphenal) Waste Oil Volume I. Summary

GCA Corp.
Bedford, MA

Prepared for

Industrial Environmental Research Lab.
Research Triangle Park, NC

Mar 81

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EPA

Research and Development

APPLYING FOR A PERMIT TO DESTROY PCB WASTE OIL

Vol. I. Summary

Prepared for

Office of Toxic Substances

Prepared by

Industrial Environmental Research
Laboratory
Research Triangle Park NC 27711

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Cover 2

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March 1981

Applying for a Permit to Destroy PCB Waste Oil

Volume I. Summary

by

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Contract No. 68-02-2607
Task Order No. 33
Program Element No. C1Y1B

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ABSTRACT

This report documents the permitting process followed by the State of Michigan before allowing a trial destruction burn of polychlorinated biphenyls (PCBs) at the Genral Motors (GM) Chevrolet Bay City plant. The report is divided into two volumes. Volume I includes a chronology of events and a matrix depicting the interaction of Federal, state, and local government agencies and GM in the permitting process. The matrix presents a list of who requested and who responded to each need for additional information. An analysis of the significance of interactions, including interagency communications, private sector-public communication, and the flow and quality of information developed, is provided. Finally, recommendations that are based on this permit application process and that might facilitate subsequent permit applications for burns of hazardous materials are made.

Volume II of this report contains the relevant documents summarized in the lists presented in Volume I. Copies of Volume II may be obtained on request from EPA.

This work was performed under Contract No. 68-02-2607, Task Order No. 33 during the period May 1979 through December 1979.

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SECTION 1

INTRODUCTION

BACKGROUND OF NEED FOR PERMIT APPLICATION

Before the enactment of the Toxic Substances Control Act (TSCA) in October 1976, the EPA's authority covering polychlorinated biphenyls (PCBs) was limited to the regulation of contaminated water from point sources. In the Clean Water Act of February 2, 1977 under Section 307(a) (42FR6532-6556), the Environmental Protection Agency (EPA) promulgated a rule banning the discharge of PCBs into navigable waters by electrical transformer and capacitor manufacturers.

Then, on February 17, 1978 (43FR7150-7164), acting under TSCA, the EPA promulgated a rule regulating the disposal of PCBs and requiring that special warning labels be applied to large capacitors, transformers, and other PCB items. This Disposal and Marking Rule covered liquid PCBs as well as other material and equipment components containing or having contained PCBs in concentrations greater than 500 ppm. This rule was further clarified by amendments published on August 2, 1978 (43FR33918).

The Final PCB Ban Rule appeared in the Federal Register on May 31, 1979 (44CFR761:31514-31568) and took effect on July 2, 1979. This rule integrates the February 17, 1978, PCB Disposal and Marking Rule with the Production Ban Rule; therefore, the Final Ban Rule provides the total scope of PCB regulations up until July 2, 1979, its effective date. These regulations have led to the accumulation of large volumes of PCP-contaminated fluids while sources attempt to develop and use acceptable means of disposal as provided by Subpart B.

One source of PCB-contaminated fluids is produced by the contamination of process machinery oils by PCB residuals. PBCs had been used previously in cutting oils because of their flame retardant properties, which provide greater machine operator safety. Because of the tenacity of PCBs to surfaces, each time the machinery is flushed with oil free from PCBs, the flushings become contaminated by residues in the machinery.

The EPA has established that if the PCB concentration of these fluids is in the range of 50 to 500 ppm, the fluid may be destroyed by incineration in an industrial boiler. The Federal regulation (40CFR761) stipulates that:

(1) the boiler must be rated at least at 50 million Btu/hour,

(2) the PCB-contaminated waste must constitute no more than 10 percent of the total volume of fuel,

(3) the waste must not be added to the boiler during startup or shutdown,

(4) certain combustion and fuel feed conditions must be monitored during the burn,

(5) the regional EPA administrator must be notified within 30 days of the proposed burn, and

(6) the regional EPA administrator must grant approval for the burn.

The facility at Bay City, Michigan, run by Chevrolet Division of General Motors (GM) is presented with the problem described above, having accumulated approximately 60,000 gallons of hydraulic fluids contaminated with PCBs in the concentration range of 50 to 500 ppm. This facility has the following basis for disposing of its wastes by incineration.

- It possess two boilers in the size range required by EPA for incineration of waste oil.

- It possess a large volume of PCB-contaminated oil in the concentration range allowed by EPA for industrial incinerator destruction.

- It had previously burned PCBs in its boilers, and its tests showed excellent destruction efficiencies.

- After receiving notification from Mr. Potter, Vice President for Environmental Activity of GM, EPA had contacted GM and asked if they would be willing to conduct the test.

In addition to notifying the EPA regional administrator, Michigan air quality regulations require that GM obtain a permit from the State Air Quality Division under Michigan Act No. 348, Rule No. 21. This regulation provides that any source of contamination to the air needs a permit to operate. Thus, a permit is necessary for any construction, reconstruction, and alteration of any process, fuel burning equipment, or refuse burning equipment that is a potential source of air contaminants. No specific procedure for obtaining the permit is outlined in the regulation, and public comment period, at staff discretion, is used in significant or controversial cases only.

Because of the regulatory requirements, certain engineering and operating protocols were established by GM and EPA's contractor, GCA Corporation in support of anticipated technical needs. The Appendix contains a copy of the analytical sampling and analysis support developed by GCA Corporation. In addition, this Appendix presents the preliminary environmental analysis, including dispersion modeling and relevant health and ecological standards considered important for evaluating the proposed burn.

PARTICIPANTS INVOLVED IN PERMITTING PROCESS

Because many groups and individuals will be mentioned in this report, it is appropriate that a comprehensive list be presented here for reader reference as the report is read. A list of persons and phone numbers is also available in Volume II of this report.

EPA:

Office of Pesticides and Toxic Substances, Control Action Division
- William Gunter, Team Leader PCB Team (8/79-Present)
- Hal Snyder, Team Leader PCB Team (through 8/79)

Office of Research and Development, Industrial Environmental Research Lab
- David C. Sanchez, Project Officer (7/25/79-Present)
- Ronald A. Venezia, Project Officer (4/79-7/25/79)

Regional Office, Region V
- Y. J. Kim

GCA/Technology Division:
- Steven G. Zelenski, Project Manager

General Motors:
- Donald R. Koenig, Plant Engineer, Bay City Plant
- Larry L. Johnson, Senior Mechanical Engineer, Facilities and Environmental Engineering, Chevrolet Main Plant (Warren, MI)
- Alvin P. Garwick, Senior Mechanical Engineer, Bay City Plant
- J. David Hudgens, Chevrolet Public Relations
- Anthony R. Fisher, Environmental Activities Staff, GM Corporation
- Frederick Fromm, Legal Staff, GM Corporation
- Thomas Hockman, Plant Medical Director, Bay City Plant

State of Michigan:

Air Pollution Control Commission
- Maurice S. Reizon, Chairman
- James A. Brewer, Sr.
- Watson A. Gilpin
- Mary L. Graves
- Edward L. Klopp, Jr.
- Donald R. Naish
- Glenda F. Robinson
- Edwin S. Shannon
- Morton Sterling
- W. G. Turney
- Emmanuel Van Nierop

Air Quality Division, Department of Natural Resources
(see Figure 1, Organization Chart)
Howard A. Farmer, Director
Del Rector, Chief, Air Quality Division
George Su, Technical Services Section
Gerry Avery, Head, Permit Unit
John Vial, Engineer, Permit Unit

Interest Groups:
Bay City residents
United Auto Workers Local 362
Andre Day, Boiler Operator
American Lung Association of Michigan
City Commission
County Commission

This list does not include the names of all the people who may have been involved in this permit application process. The list, however, does include the principals in the process.

BACKGROUND OF PUBLIC SENTIMENT REGARDING INCINERATION OF PCBs

At the time of GM's application for a permit for the incineration of PCBs, public invovlement and awareness of the process of PCB destruction by incineration had already become significant. In mid-1977, Peerless Cement Company in Detroit, Michigan, had requested permission to store and incinerate PCB-contaminated waste fluids on a commercial basis. Although the State Air Quality Permit Section recommended approval of a permit and much expert testimony was received in favor of the safety and efficacy of the cement kiln for destroying PCBs, the permit was not granted. It is not within the scope of this report to analyze the reasons for denial, but much public awareness and emotion was generated by the public hearings and press coverage associated with the permit application process. In addition, a significant polybrominated biphenyl (PBB) spill had occurred within the last 2 years and much press coverage had been devoted to detailing the hazards of this class of compounds, which are related to PCBs. Finally, comments in the public record of the Peerless Cement Hearings and limited reading of press coverage of that hearing, indicate that much public awareness and anxiety related to incineration of PCBs were generated. It was at this stage that GCA/Technology Division received a Task Order for sampling and analysis assistance to accomplish the test. The resulting Test Plan is included as an appendix.

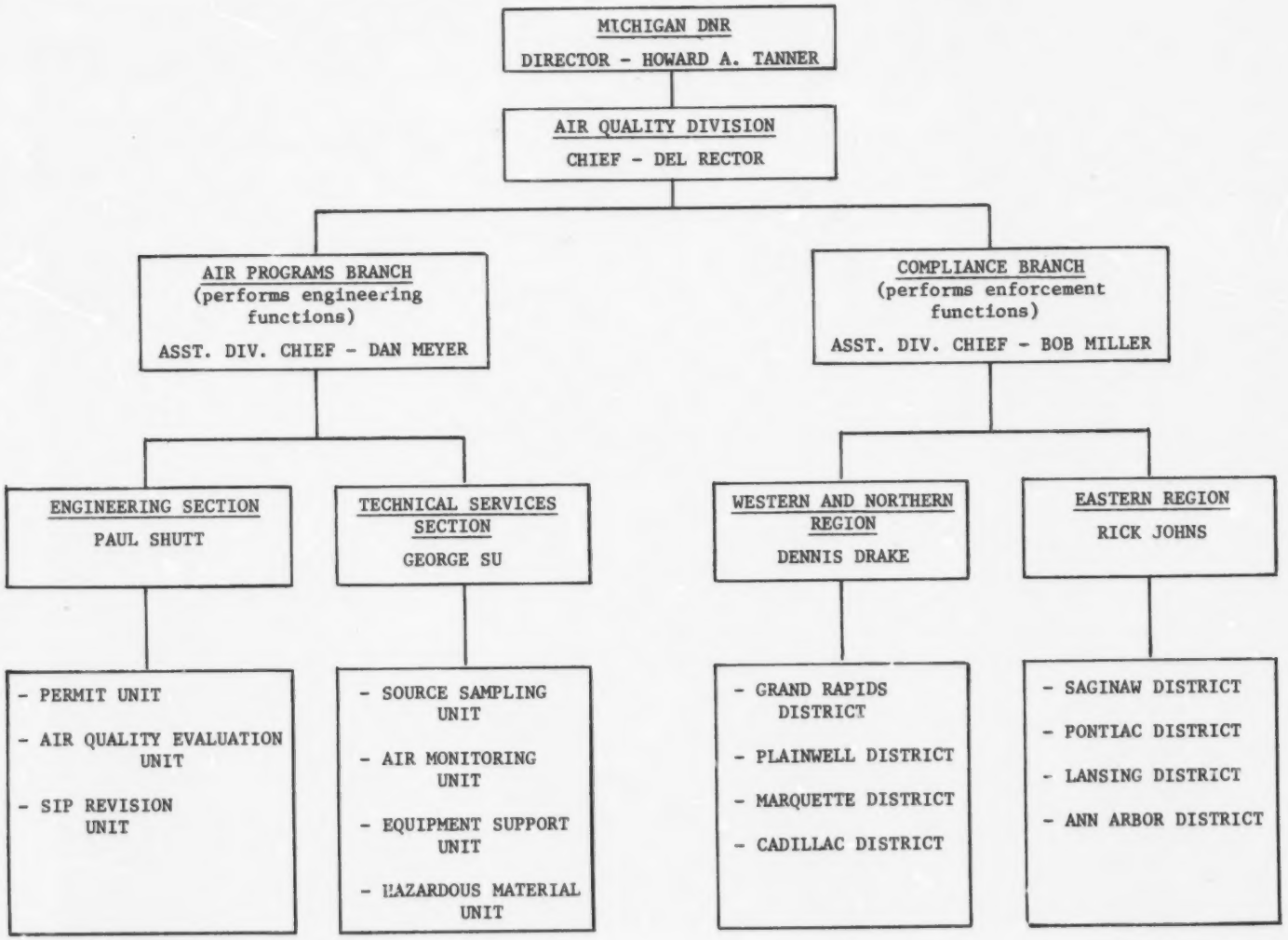

Figure 1. Organization chart of Air Quality Division of Michigan Department of Natural Resources.

SECTION 2

CHRONICLE OF EVENTS

To provide an understanding of the path taken by the permit application process to date, a chronology of events is included in this report. It is impossible to document all events that might have played a part in this permit application process; however, events that were a part of the process or that appeared to influence the process are included. No events that might have been important to the permit application process have been knowingly omitted. This list includes major announcements, communications, meetings, requests for information, responses to requests for information, news releases and press headlines. Dates cited are referenced to correspondence or official records and, in some cases, to personal handwritten notes. Dates that are based on handwritten records are noted with an asterisk in the following chronology. Copies of all available documentation of events cited in this chronology are presented in Volume II of this report.

The chronology indicates that there have been three phases governing the incineration disposal of PCBs at the GM-Bay City plant. The first, or pre-regulatory phase, was the period between 1974 and Fall 1977 when PCBs were incinerated at the plant without restrictions. This period occurred before any GCA involvement.

The second or regulatory phase was initiated by state-applied restrictions on PCB incineration. Regulatory action was intensified when EPA issued PCB regulations. During this phase, from Fall 1977 to mid-1979, the structure of the PCB incineration permit and permitting process was gradually developing as the control agencies gained implementation experience.

Failure to supply sufficient data to meet Federal combustion criteria for PCB disposal was cited in 1978 by the DNR as reason for GM permit application denial. It was apparent that GM would require technical assistance in obtaining the incineration permit. The commercial availability of PCB incineration facilities had become an EPA waste management goal, thus, in the interest of that goal, EPA contracted GCA/Technology to provide active assistance to GM in the permit process. GCA's initial involvement was to gather technical information to support GM's permit application efforts.

The third phase was characterized by the interactions of the press and public in the already complicated permitting process. This period was replete with the public hearings, agency inquiries, GCA responses, incineration disposal support/condemnation statements, and decision delays. GCA's role was broadening as areas of concern expanded from combustion details to estimating human and environmental impact of PCB incineration.

PRE-1979 PERMIT APPLICATION CHRONOLOGY

1974-1977	PCB Waste Oil Burned at Chevrolet-Bay City
7/14/77	DNR denied Chevrolet-Bay City Exemption Application.
9/02/77	DNR Stopped PCB Waste Oil Burning
9/06/77	Chevrolet-Bay City Applied for Permit
11/03/77	Chevrolet-Bay City Withdrew Permit
2/17/78	EPA Issued PCB Regulations
3/27/78	Chevrolet-Bay City Issued Pollution Incident Prevention Plan Including PCB Handling and Disposal Procedures
4/17/78	Chevrolet-Bay City Applied for Permit to Burn Reclaimed Oils
5/10/78	SS. Unit Michigan DNR Notified Permit Unit that PCB Test on May 17, 1976 Was Unacceptable
6/02/78	Chevrolet-Bay City Was Notified of DNR Recommendation to Deny Permit
6/20/78	DNR Staff Activity Report on Chevrolet-Bay City Issued.
6/15/78	Chevrolet-Bay City Requested Withdrawal of Permit Application.
6/28/78	DNR Notified Chevrolet-Bay City of 30-Day Limit to Appeal Voiding of Permit Application
11/02/78	Letter from Potter (GM) to Costle (U.S. EPA) Recommending that EPA Choose Incineration Facilities
1/11/79	Ontario Ministry of the Environment Issued Press Release on Release of Mississauga Report.
1/79	Ontario Ministry of the Environment Released Highlights of the Ontario Research Foundation Report.

CHRONOLOGY CONCERNING CHEVROLET-BAY CITY'S 1979 PERMIT APPLICATION

4/06/79	EPA Requested GM Boiler for PCB Burn
4/18/79	Work Assignment Issued for GCA to Test PCB Emissions.
4/18/79*	Meeting of EPA, GM, and GCA Held to Discuss Testing of PCB Burning at GM

4/25/79	GCA Work Plan Sent to GM and U.S. EPA
5/01/79	GCA Sent Revised Project Schedule to GM and EPA
5/23,24/79*	Meeting of EPA, GM, and GCA Held to Discuss Necessary Conditions for Permit Issuance
5/29/79	GM Sent Air Use Permit Application to EPA
5/31/79	EPA PCB Regulation Updated
5/31/79*	GCA Performed Pretest Survey of Site at Bay City
6/06/79	Meteorological Model Representing Dispersion Prepared
6/11/79*	Meeting of GCA, GM and EPA Held in Washington, D.C. to Refine GCA Environmental Analysis on Burning PCBs at Chevrolet-Bay City
6/18/79	Meteorological Model Revised to Include Deposition Test Plan of PCBs.
6/22/79	GCA Mailed Final Draft of Test Plan to EPA and Chevrolet-Bay City
6/27/79	Chevrolet-Bay City Applied for Air Use Permit to Michigan DNR
7/06/79	Chevrolet-Bay City Sent EPA Air Use Permit Application
7/23/79	John McGuire (Regional Administrator, EPA) Requested Support of Howard A. Tanner (Director, Michigan DNR) in Testing PCB Emissions and to Classify as Not a "Major State Action" so that No Environmental Impact Statement Would Be Necessary.
7/24/79*	Meeting of GCA, GM, EPA, and DNR in Lansing, Michigan
7/27/79	GCA Sent Letter to Chevrolet-Bay City Including Vapor Pressure Data and Related Materials for Use in Estimating PCB emissions
7/27/79	Chevrolet-Bay City Mailed Letter to DNR Regarding Information Requested
7/27/79	U.S. EPA Sent GM Summary of Data on PCB Levels in Ambient Air
8/09/79*	Compass Directions and Distance to Property Line Obtained from Al Garwick
8/14/79	Meteorological Model Revised PCB Concentrations at GM Property Line

8/15/79*	Information on Distance to Nearest Residential Areas Obtained from Al Garwick
8/16/79	Meteorological Model Revised to Include PCB Calculations at Nearest Residential Area
8/17/79	GCA Sent Data Requested by George Su to Michigan DNR
8/30/79	Meteorological Model Revised to Include Time Averaged PCB Concentration from 2-minute Full Release
9/06/79	GCA Sent John Vial Written Confirmation of OSHA Standards
9/10/79*	Conversation Between John Vial and Al Garwick Concerning 21 or 30-day Comment Period
9/13/79*	Conversation Between Sanchez and Garwick Requesting Notification to Region V of Proposed Burn Date and Reference to the July 6 Letter to Hal Snyder
9/18/79	Chevrolet-Bay City Sent EPA Region V Letter Requesting Verification of October 22 Burn Data
9/19/79	Michigan Air Pollution Control Commission Issued Notice of Public Comment Through October 15 and Public Hearing October 16
9/20/79	Included PCB Concentrations at Plume Sector Cutoff Points in Meteorological Model
9/21/79	DNR Proposed Conditional Approval
9/28/79	Michigan Air Pollution Control Commission Announced Public Comment Through October 15 and Public Hearing on October 11 and October 16
9/28/79	The Bay City Times "Chevy Gets OK to Burn PCB Oil Contaminants"
9/28/79	DNR Notified Chevrolet-Bay City of Additional Public Hearing
10/03/79	The Bay City Times "Operators Label Boiler Unsafe for Burning PCB"
10/09/79	Position Paper Released Describing PCB Burn Including Action Taken by GM, GCA, EPA
10/09/79	Manistique Pioneer-Tribune "Air Commission to Hear PCB Incineration Proposal"

10/10/79	The Bay City Times - Notification Requested UAW Members to Attend November 12 Commission Meeting
10/10/79	New Views (GM) Released Information to Chevrolet-Bay City Employees on Burning
10/11/79	Meeting in Bay City-Public Hearing
10/11/79	The Bay City Times "Hearing Today on Chevrolet Request to Burn PCB"
10/11/79	The Detroit News "GM Wants to Burn PCB at Chevy Site"
10/11/79	The Flint Journal "EPA Backs Request to Burn Toxic PCB"
10/12/79	The Bay City Times "Union Workers, City Official Protest PCB Test Burn"
10/15/79	Ontario Ministry of the Environment Provided EPA with Their Protocol for Incinerating PCBs in a Cement Kiln
10/16/79	Meeting in Bay City - Commission Meeting
10/16/79	The Bay City Times "PCB Burn Decision Delayed"
10/16/79	Unknown "Group Condemns PCB Burning"
10/16/79	DNR Requested Delay from MAPCC
10/16/79	Mt. Clemens Macomb Daily "PCB Disposal"
10/16/79	South Haven Daily Tribune "ALA Against PCB Burn"
10/17/79	The Bay City Times "Bay City 'Show' Gets Results on PCB Plan"
10/17/79	The Hillside Daily News - "Burning of PCB Oil Delayed"
10/17/79	The Detroit News "State Delays Test - Burning of PCB"
10/17/79	St. Joseph Herald Palladium "State Seeking Answers Before PCB (sic) Is Burned"
10/17/79	Grand Rapids Press "PCB Buildup At Issue in GM Bid to Burn Oil"
10/22/79	U.S. EPA Sent GM OK to Burn PCBs
10/25/79	John Vial (DNR) Sent Chevrolet-Bay City List of Questions from the Public Hearings to be Answered

11/01/79	GM Prepared "Response to News Media Inquiries on the Medical Examinations of Employees at Chevrolet's Bay City Plant, Site of the Proposed PCB Test Burn"
11/01/79	The Detroit News Editorial "PCB's are Not Easy to Dump"
11/02/79	The Bay City Times "Bay City Chevrolet to Test Workers for PCB Poisoning"
11/05/79	The Bay City Times "Canadian Officials to View Bay City Chevrolet's PCB Burn"
11/08/79	DNR Letter to Concerned Citizens Included Staff Summary and Announced November 20 Meeting
11/08/79	DNR Notified GM of Meeting on November 20; Agenda Included
11/08/79	Proposed Supplement to Permit Application Drafted by DNR
11/10/79	The Bay City Times Letter to the Editor "PCB Test Burn Should Concern the Community"
11/12/79	Bay City Commission Opposed the Burn
11/13/79	The Bay City Times "Commission Opposes Chevy Waste Oil Test Burn"
11/13/79	Bay County Commission Asked for Delay of Burn
11/14/79	The Bay City Times "County Board Opposes Chevy's PCB Test Burn"
11/16/79	DNR Notified GM that Application for Permit was Voided Because of GM's Request to Withdraw Pending Further Investigation
11/16/79	The Bay City Times "Expect Month's Delay for PCB Burn Here"
11/16/79	Meteorological Model Revised to Reflect Winter Conditions
11/20/79	Commission Meeting in Lansing, Michigan. GM Presented Their Position - Requested Delay Until December 18 Meeting. A Question and Answer Period followed.
11/20/79	Addendum to DNR Staff Activity Report of October 16 Includes Revised Special Conditions
11/20/79	The Bay City Times "Delay Expected in Decision on PCB Burn"
11/21/79	The Bay City Times "PCB Test-Burn Proposal: GM Gets Month to Sell City on Plan, Bay Environment Office Favors it"
11/26/79	GM Responded to DNR Answering Questions from Mr. Morton Sterling
11/27/79	The Bay City Times "GM Woos City on PCB Burn"

11/27/79*	GCA Communicated with U.S. EPA (Sanchez) Regarding Report of Application Process
11/28/79	GM Letter to U.S. EPA (Sanchez) Addressed Test Burn Date in 1980
11/28/79	PCB Blood Serum Results Received
11/28/79	Ontario Ministry of the Environment Published Fact Sheet on PCB's Stating that They Have Found it is Safe to Burn PCBs
11/30/79	Results of PCB Blood Tests Released to the Press
12/01/79	The Bay City Times "Local Chevy Workers PCB Levels Up, but Within Average Range"
12/01/79	The Bay City Times "Laws Regulating Toxic Chemicals are Riddled with Loopholes" on Talk by William Cooper
12/06/79*	Telephone Conversation with John Vial - Discussed TAGA 3000
12/11/79*	Telephone Conversation with Tony Fisher. GM Requesting a 60-day Delay. Stated that It Is Not Necessary for GM, GCA or EPA to Appear at December Hearing of MAPCC.
12/11/79	Letter From Koenig (GM) to Rector (DNR) Requested Postponing Decision on the Test Burn Until the February 1980 Commission Meeting
12/11/79	DNR Posted Notice of Cancellation of Consideration of the GM Permit Application From the Agenda of the December 18 MAPCC Meeting
12/12/79	GM Press Release Concerning Postponement of Application Decision Released
12/13/79	The Bay City Times "Chevrolet-Bay City Asks State to Delay Test-Burn Decision"
12/14/79	Copy of GM Press Release Sent to DNR

SECTION 3

INFORMATION REQUIRED DURING PERMITTING PROCESS

As noted earlier, EPA originally contracted GCA/Technology Division to provide the sampling and analysis support required by EPA. The original work plan and pretest survey were begun to provide this service. However, as the permit application process in the State of Michigan progressed, it became apparent that the State Air Quality Permit Division would require additional information to allow informed processing of the permit application. As these requests were made by various members of the Permit Division or by the public through public hearings, information was supplied by a variety of sources, including the Region V Office, GCA/Technology Division, and GM.

The chronology presented in the preceding section details these requests. However, it is also of interest to see who requested the information and who provided it, as well as the delay between the request and the provision. In addition, it would also be helpful to note when participants in the process were introduced. Therefore this information is presented in the matrix display shown in Table 2, which allows these factors to be rapidly surveyed and also allows certain conclusions to be drawn.

Perusal of the table immediately reveals a significant fact: GM worker and other public interaction did not occur until the permit application process was well underway. Another important observation is that the overwhelming number of questions relate to potential health effects of PCB emissions. Little concern was apparently expressed for the technical merits of the sampling and analysis plan nor for the ecological (nonhuman) effects of PCB emissions. However, about one-half of responses shown in this table were produced by GCA/Technology Division, which shows the evolving role of GCA/Technology Division in providing the necessary information not directly related to the sampling and analysis program, but essential to the permit process.

TABLE 2. DISPLAY DEPICTING TYPES OF INFORMATION REQUESTED, WHO REQUESTED IT, AND WHO PROVIDED IT, ALONG WITH DATES FOR EACH EVENT

Information requested	DNR	GM	EPA	GCA	Boiler operators	Public	Ontario Min of the Env.	Remarks
Sampling & Analysis Plan			R5.24.79	P6.22.79				Test Plan for the Evaluation of PCB Destruction Efficiency in Industrial Boilers
Environmental Analysis	R5.23.79		R5.24.79	P6.11.79				Environmental report refined at June 11 meeting of EPA, GCA, and GM
Ground Deposition Rates for PCBs	R6.11.79			P6.18.79				
Measuring Accuracy of Continuous Monitors	R7.24.79			P8.17.79				
PCB Sampling Train/ Quantification Process	R7.24.79			P8.17.79				
Ambient PCB Levels in Various Cities	R7.24.79		P7.27.79					
PCB Exposure Limits	R7.24.79			P8.17.79				
PCB Emissions From Storage Tanks	R7.24.79	P9.10.79						
Sample Calculations for PCB Emissions		R7.24.79	P7.27.79					
Location of Proposed Check Valves for Reclaim Oil	R7.24.79	P9.10.79						
PCB Concentration off GM Property	R7.24.79	P8.9.79						
PCB Concentration off GM Property		R7.24.79		P8.9.79				Meteorological Model Revised
Distance to GM Property Line		P8.9.79		R8.8.79				
PCB Concentration at Nearest Residential Area	R7.24.79	P8.18.79						
PCB Concentration at Nearest Residential Area		R8.10.79		P.8.16.79				Meteorological Model Revised
Distance to Nearest Residential Area		P8.15.79		R8.14.79				
Model for 2 min Full PCB Release	R8.29.79			P9.6.79				Meteorological Mode Revised
Information Concerning OSHA PCB Standards	R9.4.79			P9.4.79				

(continued)

TABLE 2 (continued)

Information requested	DNR	GM	EPA	GCA	Boiler operators	Public	Ontario Min. of the Env.	Remarks
PCB Concentrations in Plume at Cutoff Points	R7.24.79			P9.20.79				Meteorological Model Revised
Inspection of Boiler and Repair of Holes		P10.5.79			R10.3.79			
Clarification of Meteorological Model			R10.4.79	P10.11.79				GCA Testimony at October 11 Public Hearing
Information on Ontario m.v. Vulcanus operation			R10.12.79				P10.15.79	Sent Protocol for Use of Cement Kiln for PCB Destruction
OSHA Standards for PCB		R11.25.79		P11.25.79				
Answers to 13 Questions About Permit Application (dibenzofurans, discharge water storage, etc.)	R10.17.79	P11.26.79						
Effects of Winter Conditions of Meteorological Model	R11.8.79			P11.16.79				Revision of Meteorological Model
PCB Levels in Boiler Room Workers		P11.28.79			R11.1.79	R.11.1.79		Boiler Room Workers and Control Group Tested for PCB in Blood
Information on TAGA 3000	R11.20.79			P12.6.79				Agreed TAGA 3000 Not Suited to Needs of Bay City

R = Requested

P = Provided

SECTION 4

PRESS COVERAGE OF PERMIT APPLICATION PROCESS

The Michigan press had already had an influence on this permit application process because of coverage of the Peerless Cement Permit Application 2 years previously. The press had been the major source of public information at that time, and the emotionalism associated with the Peerless permit had certainly not dissipated by the time of the current permit application.

Public objection was the major problem the Chevrolet Bay City Plant encountered when applying for this permit to burn waste oil containing PCBs. As the application process proceeded, various public interest groups received their information primarily from the press and made value judgments based on this information. The Bay City Times and newspapers from neighboring cities covered the matter extensively. The coverage in itself may have influenced public opinion, which, when aroused, delayed the permit process.

PRESS COVERAGE DURING THE APPLICATION PROCESS

The proposed burning of PCBs in Bay City received front page coverage and lead story priority in the Local section of The Bay City Times. The coverage began in late September 1979 and became more extensive before public hearings. The press was particularly quick to emphasize any adverse feelings of individuals or groups as they became apparent. In fact, the boiler operators claim that they obtained their knowledge of the permit application from members of the local press. One of the early articles was entitled "Operators Label Boiler Unsafe for Burning PCB" and appeared as the lead local story. This is one example of an early headline that was apparently accurate and certainly attracted attention to the issue. However, later in the permitting process, GM issued a press release on the testing of workers (some of whom had worked in the boiler room in 1976 when PCBs were being incinerated) for PCB levels in their blood-stream. The following day, the lead story on the front page was "Bay City Chevrolet to Test Workers for PCB Poisoning." This is an example of a pejorative term "poisoning" being inaccurately used by the press to headline events as they evolved. In general, the press in Bay City had a tendency to perceive the permit process as a battle ground between good and evil rather than a means to inform and protect the public.

This type of reporting, however, was not typical. The Detroit News, the Flint Journal, the Macomb Daily, South Haven Daily Tribune, Manistique Pioneer-Tribune, Hillside Daily News, as well as others covered the development of events, and not all press coverage was antagonistic towards the test burn. In fact, an editorial by Ted Douglas in the November 1 Detroit News was very favorable to PCB burning. He gave a factual development of the issue, an analysis of alternatives, and a strong case for choosing burning as the best available alternative to destroy PCBs. His closing statement accurately summarized his opinion on this issue. "The issue comes down to two choices: do nothing or try something. There are risk to both.... The Commission must try something, or the problem will never be solved.

Finally, it is clear that the press provided virtually all of the information that the public received on the permitting process. In the early stages of the permitting process, the information was largely based on investigative reporting rather than on information supplied by GM, DNR, or EPA. As the process progressed, more information was funneled to the press from the public relations arms of GM and DNR. The early impressions made by the press, however, were difficult to counter. Thus, a partially informed press and public were left to their own devices to evaluate a technically complicated problem and its proposed solution. Because the press coverage was so important to the evolution of the permitting process, copies of much of the available press coverage are presented in Volume II of this report.

SECTION 5

CONCLUSIONS AND RECOMMENDATIONS

Perusal of the events detailed in this report describing the permit application process can present a confusing picture. However, certain conclusions based on the progression of events and documentation presented in previous sections can be drawn. Although each permit application process is unique, these conclusions may be representative of the difficulties that could be encountered in any similar process.

- The public, either directly or through elected representatives, was not informed of the proposed permit application during the early planning stages.

- Special interest groups, i.e., the Michigan Lung Association, the Michigan Branch of the American Cancer Association, and United Auto Workers, were not informed of the proposed permit application during early planning stages.

- The GM personnel to be involved in the test resulting from approval of the permit application were apparently not initially informed of the permit application, but were informed only when queried by the press.

- The public has, by legislation, an important influence on the permitting process.

- Previous incidents in the state, such as the Peerless Cement Co. permit application for PCB incinerations and the PBB spill incident, had already formed much of the public's attitude toward hazardous waste disposal.

- GM-Chevrolet Bay City did not adequately anticipate the public's and special interest groups' needs for information.

- Information finally provided to the public and special interest groups by nonmedia sources such as presentations at public hearings was perceived as too technical.

- There was apparently a lack of adequate communication and of clearly delineated responsibility assignments between participants in the permit application process.

Although these are certainly not the only conclusions that may be drawn from the available documentation, they do represent a composite of: (1) a distillation of the documentation and (2) the problems cited most by participants in the permitting process during informal interviews.

If these conclusions accurately reflect the incidents that occurred as part of the permitting process, certain recommendations to facilitate similar action in the future are appropriate.

1. Identify all groups that may play an important role in future permitting process.

2. Contact these groups by letter or personally.

3. Develop a relationship of cooperation with these groups.

4. Determine level of support for proposed action, and determine necessary course of action based on level of support.

5. If warranted, proceed with formal permit applications.

In conclusion, the following quotation from Carl Sagan may be appropriate:

"To facilitate informed public participation in technological decision making to decrease the alienation too many citizens feel from our technological society...we need better science education. The most effective agents to communicate science to the public are television, motion pictures and newspapers..."

APPENDIX A

GCA/TECHNOLOGY DIVISION
ORIGINAL TEST PLAN

TEST PLAN FOR EVALUATION OF PCB DESTRUCTION EFFICIENCY IN INDUSTRIAL BOILERS

TEST PLAN

MAY 1980

Prepared by

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TEST PLAN FOR EVALUATION OF PCB DESTRUCTION EFFICIENCY IN INDUSTRIAL BOILERS

INTRODUCTION

EPA has promulgated a final rule to implement provisions of the Toxic Substances Control Act prohibiting the manufacture, processing, distribution in commerce and use of PCBs. Subpart B of 40 CFR Part 761 relates to disposal of PCBs.

In order to gather more data relative to PCB destruction efficiency of industrial boilers, a sampling and analysis protocol was developed for the boiler at the GM plant in Bay City, Michigan, which will be the test site for a confirmation test destruction of PCB. An environmental analysis assessment of the proposed burn has been included in this test plan.

The following sections address: (1) the sampling plan including details of a pretest visit to the site; (2) the analysis plan based on state-of-the-art analytical methodology; and (3) the environmental analysis based on worst case emissions estimates as well as 99.9 percent destruction efficiency.

SUMMARY

A confirmation destruction of polychlorinated biphenyls in an industrial boiler is proposed in this plan. State-of-the-art sampling and analysis methodology are used to determine both the presence and quantity of polychlorinated biphenyl which may be present in either the fuel or stack emissions during the test.

An environmental analysis assessment based on assumptions of worst case destruction and meteorological conditions has been performed. This analysis indicates that maximum levels of polychlorinated biphenyls which could be released during the test are well below regulatory levels for both human and environmental exposure. Ambient monitoring will be performed before, during, and after the test burn to document PCB background levels and any increases due to the test burn.

COMBUSTION EMISSION ASSESSMENT

The primary objective of the stack emissions assessment is to evaluate the destruction efficiency of PCB contaminated waste oil during combustion. Because of widespread concern over toxic by-product emission during the combustion, the assessment scheme attempts to correlate PCB destruction with measured emissions of HCl, dibenzofurans, chlorinated dibenzofurans, dioxins,

and total organic residue. Samples of PCB contaminated fuel will be analyzed in the laboratory for PCB content, dioxins and dibenzofurans. The fuel data will be used in conjunction with field-measured combustion parameters to determine PCB destruction efficiency.

The analysis plan which supports the stack emissions assessment is complex and will therefore be addressed in a separate section labeled "Analytical Approach." This section encompasses stack, fuel and ambient sample analyses.

STACK SAMPLING

Sampling Schedule and Methods

The proposed method for sampling PCBs in the combustion flue gas will include three complete tests of the boiler at normal load operation and burning a No. 6 fuel containing approximately 10 percent waste material and 50 ppm PCB (500 ppm PCB in the waste). The waste fuel will be fed to the boiler after a normal burn temperature has been established. The sampling will require up to 6 hours for each run. This sampling time is the minimum required based on an assumed destruction efficiency of 99.9 percent at the conditions described below, yielding approximately 10 µg of PCB for analysis.

The sampling train to be used for PCBs will be a modified RAC train as described in "A Preliminary Procedure for Measuring the PCB Emissions from Stationary Sources," W. J. Mitchell, U.S. EPA, August 26, 1976. A schematic of the train is shown in Figure A-1. The solid adsorbent tube will contain 7.5 grams of pre-extracted 30/60 mesh Florisil.

The sampling and velocity traverse will be along two diameters of the stack. A total of 44 points will be sampled to provide a representative sample of the flue gas composition.[1] A schematic of the stack and the specified sampling points are shown in Figures A-2 and A-3.

Total sampling time will be 308 min at 7 min per point. The flow rate will be approximately 0.6 ft^3/min. This sampling flow rate will yield approximately 10 µg of PCBs based on a feed rate of 4 gpm of 50 ppm PCB contaminated waste fuel with a destruction efficiency of 99.9 percent.

Sampling will be isokinetic (±10 percent) with readings of flue gas parameters recorded at every sampling point during the traverse. In the event that isokinetic sampling cannot be maintained, the train will be shut down and the problem remedied. In the event that either steady operation is not maintained, or monitored gas parameters (CO, CO_2, O_2) are out of the specified limits (Subpart B - Disposal of PCBs), the testing will be stopped until conditions are stabilized. Steady operation of the boiler will be the responsibility of GM personnel but the flue gas parameters and composition will be

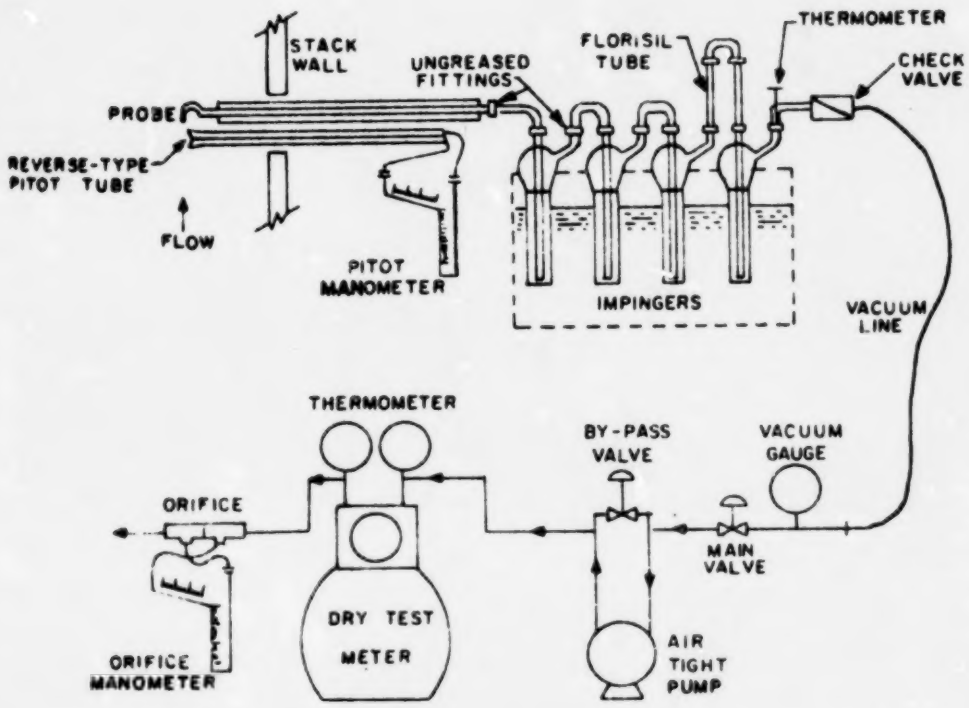


Figure A-1. PCB sampling train.

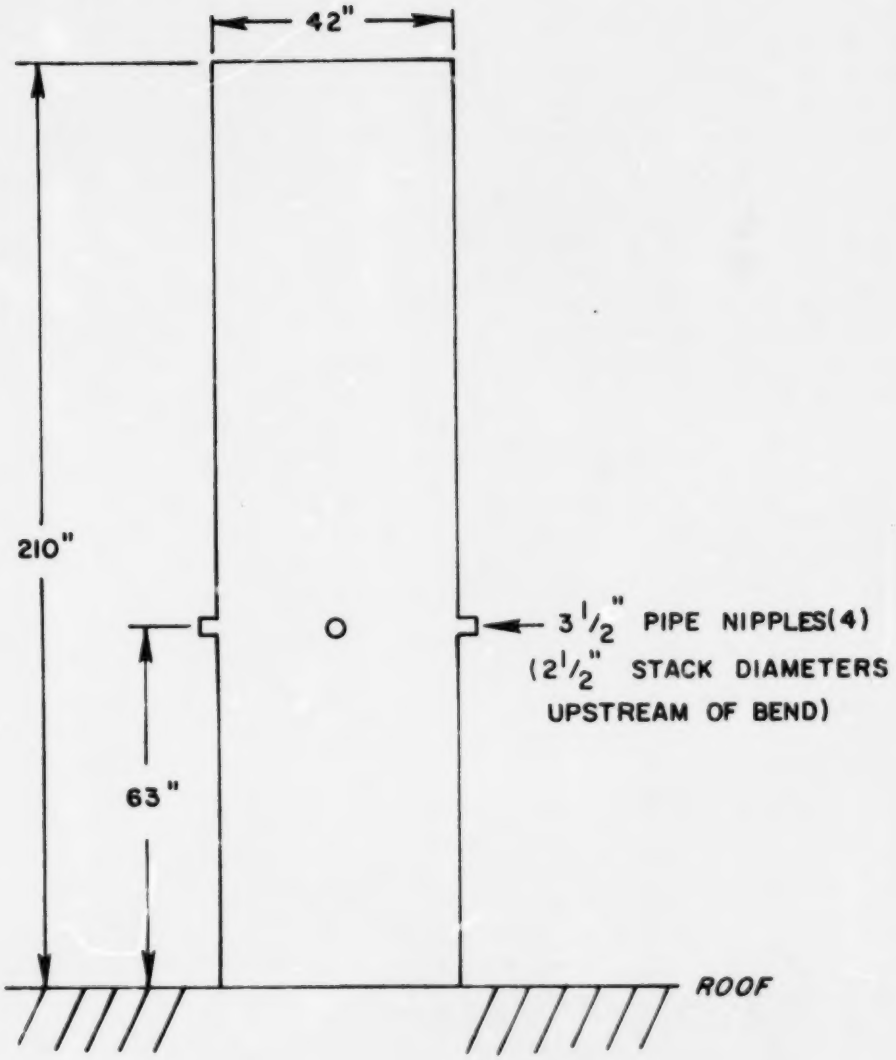
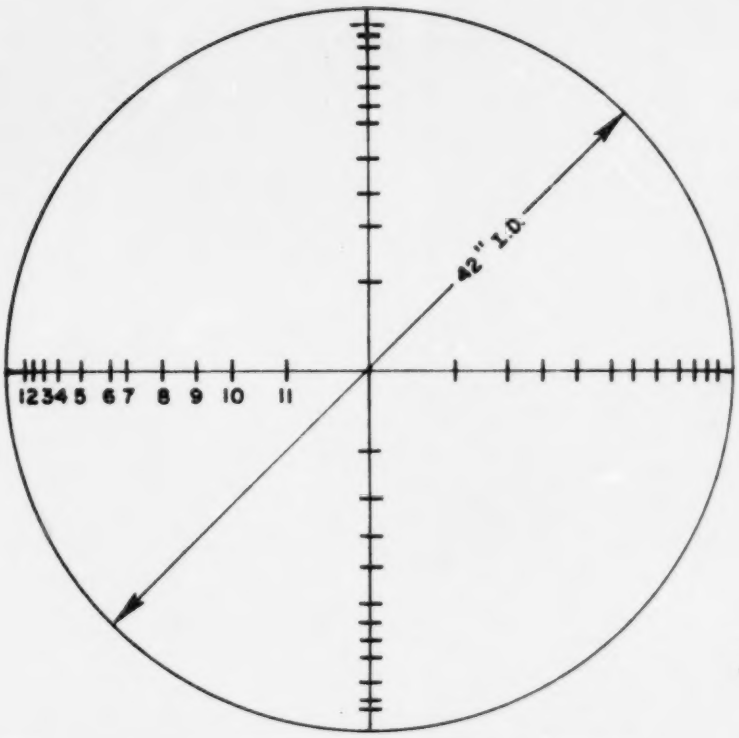


Figure A-2. Sampling ports on Stack No. 3 at GM, Bay City, Michigan.



POINT NO.	DISTANCE Inches	POINT NO.	DISTANCE Inches
1	1"	12	28 1/2"
2	1 1/2"	13	26 5/8"
3	2 1/2"	14	31"
4	3 5/8"	15	32 7/8"
5	4 7/8"	16	34 1/2"
6	6 1/8"	17	35 7/8"
7	7 1/2"	18	37 1/8"
8	9 1/8"	19	38 3/8"
9	11"	20	39 1/2"
10	13 1/4"	21	40 1/2"
11	16 1/2"	22	41

Figure A-3. Sampling points at GM, Bay City Boiler House, Stack No. 3.

monitored by GCA. Any changes will be noted and relayed to GM personnel so that appropriate action can be taken. Parameters monitored by GM are listed in Table A-1.

TABLE A-1. OPERATION PARAMETERS MONITORED BY GM AT THE BAY CITY POWERHOUSE

Parameter	Range
Fuel oil temperature	50 - 300°F
Fuel oil pressure	0 - 160 psig
Fuel oil flow rate	0 - 8 gpm
Atomizing steam pressure	0 - 160 psig
Steam flow rate	0 - 70M lb/hr
Air heater temperature IN	0 - 600°F
Air heater temperature OUT	0 - 600°F
Air heater gas temperature IN	0 - 600°F
Air heater gas temperature OUT	0 - 600°F
Air pressure IN	0 - 15 in. W.C.
Air pressure OUT	0 - 15 in. W.C.
Wind box pressure	0 - 10 in. W.C.
Furnace pressure	0 - 10 in. W.C.
% smoke density	0 - 100%

The standard Method 5 particulate train will be run simultaneously with the PCB sampling train to provide for real-time comparison samples for HCl, dibenzofuran, chlorinated dibenzofurans and dioxins analyses. The sampling will include a total of 44 points along the two stack diameters. Sampling will be at 7 min per point for a total duration of 308 min. Samples of flue gas particulate will be collected on a 4-inch glass fiber filter. In addition to total particulate, a temperature controlled adsorbent column will be included in the sampling train to collect organic emissions from the flue gas. This column, shown in Figure A-4, contains approximately 25 grams of XAD-2 resin. The temperature of the condenser is maintained at 70°F and the condensate is collected in the first impinger of the sampling train.

This sampling train will also be used to determine HCl emissions from the flue gas. The second impinger of the Method 5 train will contain 200 ml of 8 percent Na_2CO_3/H_2O as a trapping solution for HCl emissions.

In addition to the second impinger solution, an aliquot (20 percent) of the first impinger water (condensate for XAD-2 resin trap) will be taken and preserved by addition of Na_2CO_3. The remaining condensate (80 percent) will be extracted in the field with distilled in glass (D.I.G.) methylene chloride.

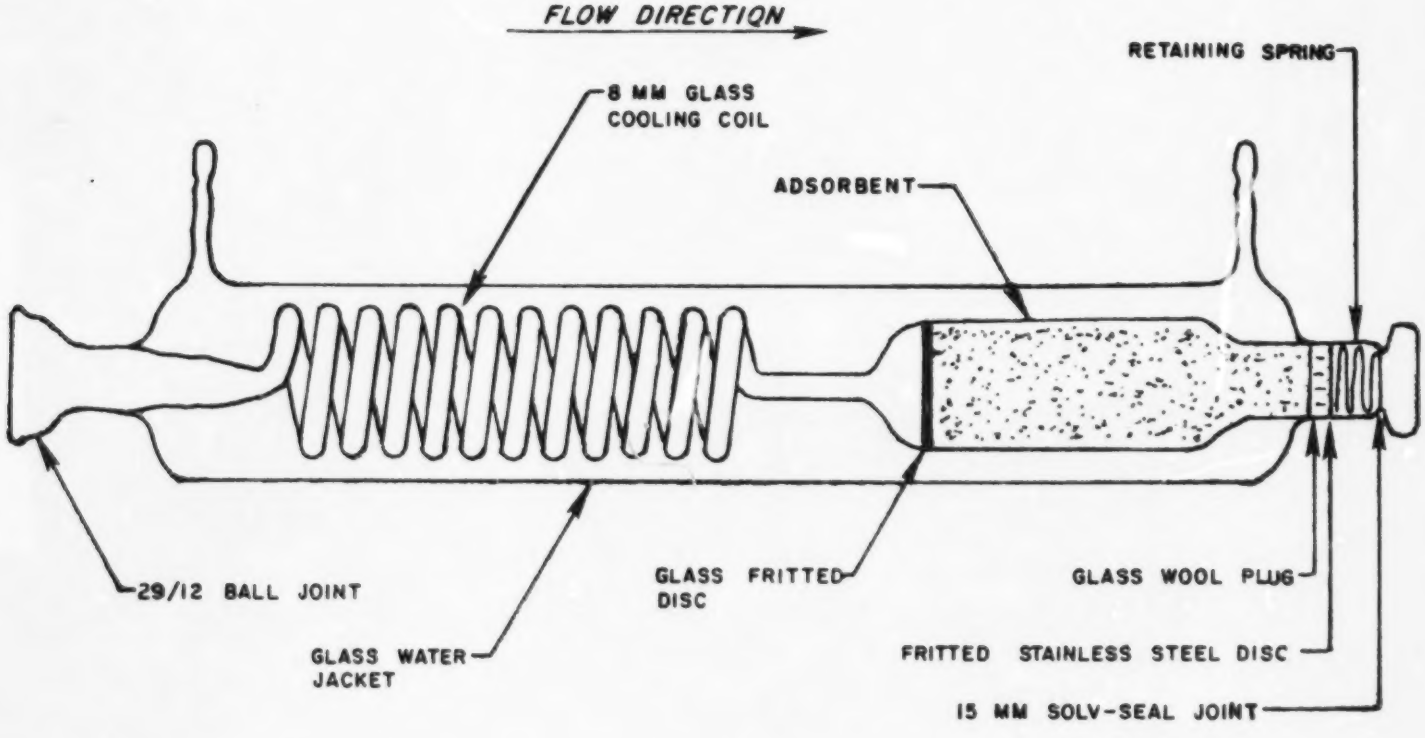


Figure A-4. Basic trap for sampling organics in gas streams.

This extract will be available for total organic residue analysis. A complete listing of samples to be taken in the flue gas stream is found in Table A-2. The flow diagrams for sample recovery are shown in Figures A-5 and A-6.

In order to provide background data on emissions from the boiler, a preliminary test will be conducted with No. 6 fuel oil only, 1 day prior to the initiation of the 3-day PCB test burn. This test will be for the same duration and at the same conditions as those to be used for the PCB sampling. The test will include both a PCB train and a standard Method 5 particulate train. This test will provide background information on the test conditions and also provide emissions data for the boiler as operated at normal load and firing No. 6 fuel oil.

A measurement of the precision of stack collection of PCB will be provided by the simultaneous operation of duplicate PCB trains on the second day of PCB waste oil burning. The Method 5 particulate train from that day will, therefore, be replaced by the second PCB train. A recent study determined that chlorinated dibenzofurans were not a significant PCB combustion product of high temperature incineration.[2] In light of these findings, it is believed that the elimination of the Method 5 train from 1 day's sampling will not compromise the total emissions hazard evaluation.

Field Parameters Measurements

During each of the four tests, various physical parameters will be measured and monitored by GCA. The operation of the boiler currently includes the monitoring of the fuel feed rate, the opacity in the stack, and steam and process temperatures. The fuel feed rate will be required during the test and other available plant data will be taken as available.

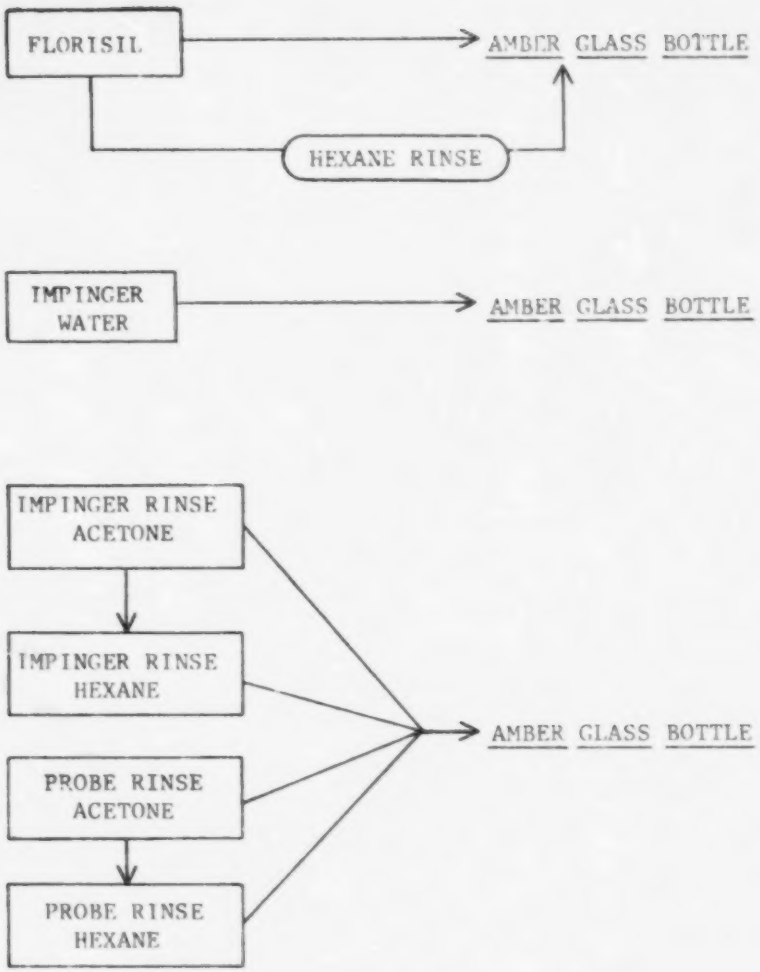
GCA will provide continuous monitoring of flue gas for CO, CO_2, O_2 and total hydrocarbons. These instruments will be set up on the third floor of the boiler room with a suitable sampling probe in the existing 2-inch port. A schematic of this sampling location is shown in Figure A-7.

The monitors will be equipped with a gas conditioning system and recorders. Monitors will be calibrated prior to use and as required. Parameters will be continuously recorded during each test.

Other physical parameters will also be measured in this testing program. These parameters include the flue gas velocity, static pressure and temperature. These measurements will be made prior to each run for the determination of proper nozzle size and sampling rate. Other physical parameters will be measured during the course of each test. A complete list of all parameters (including those for ambient testing) is included in Table A-3.

TABLE A-2. SAMPLES TO BE COLLECTED AT GENERAL MOTORS BOILER HOUSE

Sample	Source	Container	Species analyzed	Number
Flue gas particulate	Method 5 filter	Petri dish	Dibenzofurans, etc.	3
Flue gas particulate	Method 5 rinse	Amber glass	Total particulate	3
XAD-2 resin	Method 5 trap	Amber glass	Total organic residue	3
Condensate, preserved	Aliquot, Method 5 condenser	Nalgene	HCl	3
Condensate extracted	Method 5 condenser	Amber glass	Total organic	3
Na_2CO_3 solution	Method 5 second impinger	Nalgene	HCl	3
Florisil resin	PCB train	Amber glass	PCBs	5
Condensed water impinged particulates	PCB train impingers	Amber glass	PCBs	5
Train wash	D.I.G. hexane D.I.G. acetone	Amber glass	PCBs	5
Florisil blank	Blank PCB train	Amber glass	PCB background	4
Train wash blank	Blank PCB train	Amber glass	PCB background	4
Filter blank	Filter lot sample	Petri dish	Background dibenzofurans, etc.	1
XAD-2 blank	XAD-2 lot sample	Amber glass	Background organics	1
CH_2Cl_2 blank	CH_2Cl_2 sample	Amber glass	Background organics	1
Na_2CO_3 blank	Solution blank	Nalgene	Background HCl	1
Fuel feed	Trickle value (integrated)	Amber glass	Dibenzofurans, etc., PCB	4



(BLANK TRAIN RECOVERED SAME)

Figure A-5. PCB train sample recovery.

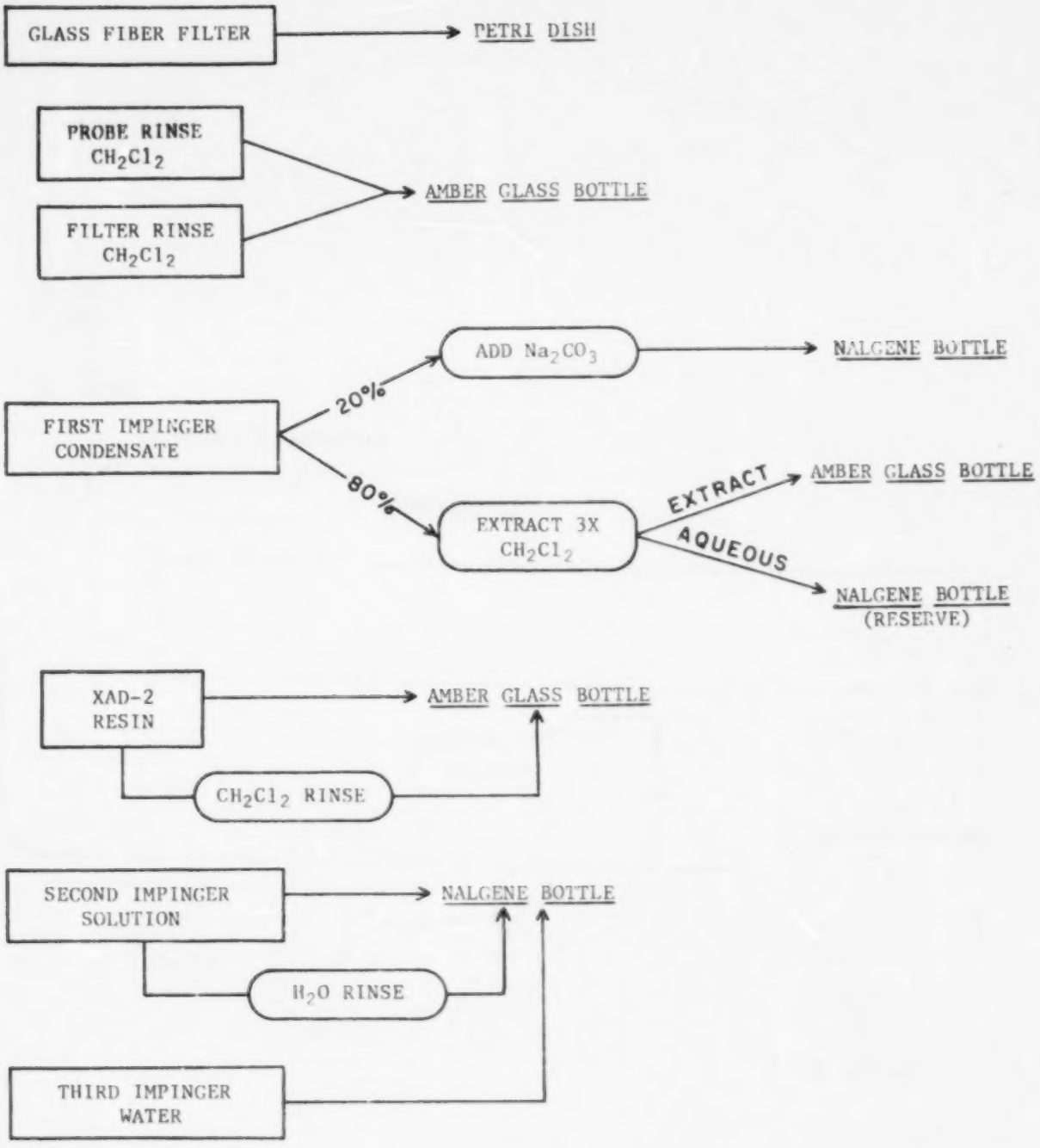


Figure A-6. Method 5 train sample recovery.

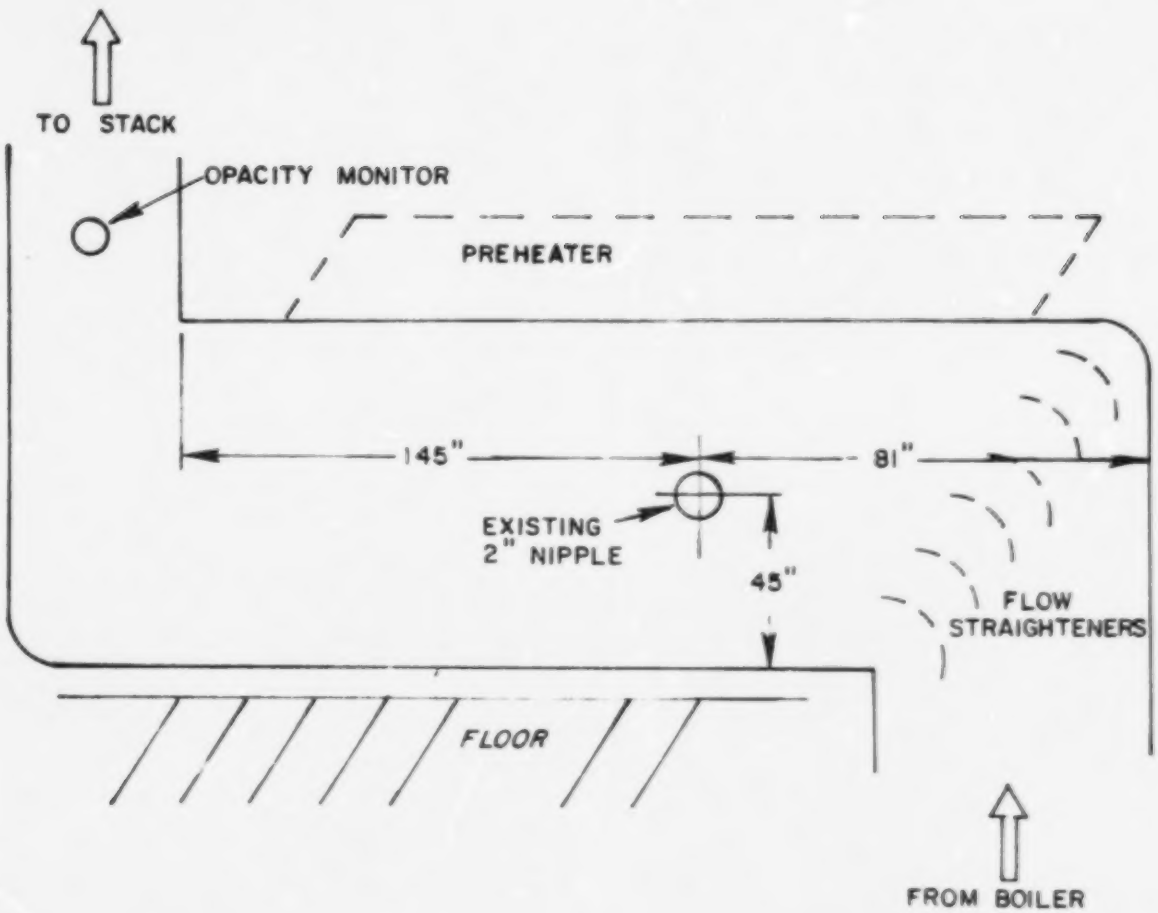


Figure A-7. Sampling port for continuous monitors.

TABLE A-3. ROUTINE PARAMETER MEASUREMENTS DURING TEST

Parameter measured	Method
Fuel feed rate	Continuous chart recording (GM)
CO_2 in flue gas	Continuous gas analyzer Infrared Ind 703-353
CO in flue gas	Continuous gas analyzer Beckman 865 (IR)
O_2 in flue gas	Continuous gas analyzer Beckman 742
Total hydrocarbons	Continuous gas analyzer Beckman 108A
Flue gas velocity	Calibrated pitot tube/manometer
Flue gas temperature	Thermocouple
Flue gas pressure	Pitot tube/manometer
Grain loading (particulate)	Results of Method 5 tests
Percent moisture in flue gas	Moisture gain in Method 5 tests
Flue flow rate	Ultrasonic flowmeter

Sampling Requirements

The stack sampling program will require 1 week of testing with five team members on site. A total of three tests and one background test of at least 5 hours, but possibly longer, will be conducted. The boiler operation will be at steady rate operation with a fuel feed rate of 4 gallons per minute.

Boiler operation, including fuel mix and delivery, will be the responsibility of GM personnel, but fuel feed samples will be drawn by a GCA team member. Other requirements to be provided by GM include the following:

- three 20 amp circuits accessible to stack;
- three 20 amp circuits for monitors;
- laboratory area for sample recovery;
- parking near building for GCA truck.

A tentative schedule is included in Table A-4.

Requirements of the ambient sampling program are discussed in the ambient testing section.

Quality Control

In order to prevent any contamination of samples with materials which may interfere with analysis, the highest level of quality control will be observed in all field testing. All solvents and resins will be checked for purity before the sampling program; filter paper and glass wool will be solvent-cleaned. Appropriate blanks will be included to provide background

TABLE A-4. TEST SCHEDULE FOR PCB TESTING AT GENERAL MOTORS

Day	Tasks, GCA	Tasks, GM
1	Arrive site, unload equipment Set up trains Set up monitors and meteorological system	Provide electric circuits, lab space, parking, meteorological system.
2	Set up for background tests Collect meteorological data Run velocity traverse Start monitoring equipment Run 5-hr PCB test Run 5-hr Method 5 test Run four 3-hr ambient tests at four locations	Establish steady run No. 6 fuel oil. Monitor fuel feed rate. Maintain ambient monitor security.
	Monitor flue gas Recover trains	Collect fuel samples (1/2-hr intervals).
3	Set up for PCB burner tests Procedure, same as 2.	Establish steady run on waste oil. Monitor fuel oil rate. Maintain ambient monitor security. Collect fuel samples (1/2-hr intervals).
4	Set up for PCB burner tests Collect meteorological data Preliminary velocity traverse Run two 5-hr PCB tests Run four 3-hr ambient tests at four locations Monitor flue gas Recover trains.	Same as 3.
5	Set up for PCB burner tests Procedure, same as 2.	Same as 3; shutdown.
6	Pack equipment, leave site	None

information. The sampling trains are all glass and are precleaned to remove any residues.[3] At no time will plastics or grease be used on the organic sample portions of the sampling train. Sample packing lists will be included for each test with information regarding source lot numbers and preservation/extraction techniques.

In addition to reagent blanks, there will be a blank PCB train set up at the sampling site, which will be recovered with each PCB run in order to provide a field-biased blank.

Each PCB train will be spiked in the field with a solution containing a known amount of deuterated tetrachlorobiphenyl internal standard. Laboratory analysis of the internal standard will provide information on sampling and analysis efficiency.

Standard QC procedures and field data sheets will be used for Method 5 testing and continuous monitor measurements. The continuous monitors will be calibrated against NBS traceable calibration gases in spectroseal cylinders prepared according to Protocol No. 1.

Data Interpretation

The major concern is to determine if the destruction efficiency for PCB destruction equals or exceeds 99.9 percent. To make this determination 3 days of testing will be undertaken (days 2, 3, and 4). For each of these days there will be one of three possible statements about the data for that day:

1. Data point valid for use, efficiency $\geq$ 99.9 percent was attained,

2. Data point valid for use, efficiency $\geq$ 99.9 percent not attained, and

3. Data point not valid for use; e.g., malfunction in system.

Ideally, the data from all 3 days will be valid for statistical analysis. However, it is possible that at least 1 day of the study may have to be discarded and so option 3 above is needed.

If all 3 days of testing are valid for use, two possible decision rules for accepting the null hypothesis that "the boiler's destruction efficiency is greater than or equal to 99.9%" can be employed. They are as follows:

Decision Rule I: Accept the hypothesis that the boiler's destruction efficiency $\geq$ 99.9 percent if all 3 days produce efficiency $\geq$ 99.9 percent. Reject the hypothesis that the destruction efficiency $\geq$ 99.9 percent if at least 1 day produces efficiency $<$ 99.9 percent,

Decision Rule II: Accept the hypothesis that the boiler's destruction efficiency $\geq$ 99.9 percent if at least 2 or 3 days produce efficiency $\geq$ 99.9 percent. Reject the

hypothesis that the destruction efficiency $\geq$ 99.9 percent otherwise.

If only 2 of the 3 days are valid for statistical analysis, a third decision rule can be employed. It is:

Decision Rule III: Accept the hypothesis that the boiler's destruction efficiency $\geq$ 99.9 percent if both of the days produce efficiency $\geq$ 99.9 percent. Reject the hypothesis that the destruction efficiency $\geq$ 99.9 percent if at least 1 of the 2 days produces efficiency < 99.9 percent.

The statistical properties of the above three decision rules depend on the boiler's "true" probability that on a given day it will produce a destruction efficiency $\geq$ 99.9 percent. In particular, if

p = Probability boiler will produce on a given day destruction efficiency $\geq$ 99.9 percent,

the probability that the above three decision rules will lead to acceptance of the hypothesis that "the boiler's destruction efficiency is greater than or equal to 99.9 percent" are:

	Probability of accepting hypothesis
Decision Rule I	p^3
Decision Rule II	$2p^2(1-p) + p^3$
Decision Rule III	p^2

Table A-5 contains values of these acceptance probabilities as functions of the true probability p. That is, Table A-5 presents the operating characteristics of these three decision rules. As is to be expected with only 3 days of testing, there are substantial probabilities of accepting the hypothesis that the boiler's destruction efficiency is greater than or equal to 99.9 percent even when the probability that such an efficiency attained on any given day is small (e.g., the acceptance probabilities for the three decision rules are, respectively, 61.4 percent, 83.1 percent and 72.2 percent, when the probability of the efficiency being $\geq$ 99.9 percent for a given day is p = 0.85).

Estimation of Sources of Variation (Components of Variance)

The present plan calls for 3 days (days 2, 3 and 4) of testing with one destruction efficiency measure per day. One reasonable mathematical model for this test plan is:

$$E_i = \mu_E + \alpha_i + \varepsilon_i \qquad (1)$$

for i = 2, 3, 4. Here

E_i is the observed efficiency for day i,

μ_E is the "true" efficiency for the 3 days,

TABLE A-5. OPERATING CHARACTERISTICS FOR DECISION RULES CONCERNING ACCEPTANCE OF HYPOTHESIS THAT BOILER DESTRUCTION EFFICIENCY $\geq$ 99.9%

Probability p that on a given day efficiency $\geq$ 99.9%	Operating characteristic		
	Decision rules		
	I	II	III
1.000	1.000	1.000	1.000
0.995	0.985	0.995	0.990
0.990	0.970	0.990	0.980
0.95	0.857	0.948	0.902
0.90	0.729	0.891	0.810
0.85	0.614	0.831	0.722
0.80	0.512	0.768	0.585
0.70	0.343	0.637	0.490
0.60	0.216	0.504	0.360
0.50	0.125	0.375	0.250
0.40	0.064	0.256	0.160
0.30	0.027	0.153	0.090
0.20	0.008	0.072	0.040
0.10	0.001	0.019	0.010

α_i is the effect of day i, and

ε_i is the random error.

A reasonable set of assumptions for the model given in (1) are:

$$\text{Mean } (\varepsilon_i) = 0, \text{ Variance } (\varepsilon_i) = \sigma^2, \text{ Concurrence } (\varepsilon_i, \varepsilon_j) = 0 \text{ for } i \neq j.$$

Given the model (1), an unbiased estimate of μ_E is $\hat{\mu}_E$ given by:

$$\hat{\mu}_E = \frac{\sum_{i=2}^{4} E_i}{3} = \bar{E}, \tag{2}$$

and estimates of the α_i are given by $\hat{\alpha}_i$ where

$$\hat{\alpha}_i = E_i - \bar{E}. \tag{3}$$

Unfortunately with model (1) there is available no unbiased estimator of σ^2. The sample variance of the E_i values given by:

$$S_E^2 = \frac{\sum_{i=2}^{4} (E_i - \bar{E})^2}{2} = \frac{\sum \hat{\alpha}_i^2}{2} \tag{4}$$

is an unbiased estimator of:

$$\sigma^2 + \sum_{i=2}^{3} \alpha_i^2 \tag{5}$$

and not σ^2 alone. The implication of this is that the plan would not allow for a separation of "within day" variability from "among day" variability.

In order to obtain a measure of "within day" variability two PCB trains must be produced on the same day. That is, two simultaneous PCB trains are needed. If this is done, then the two measurements produced can be written as:

$$E_{Dj} = \mu^D + \alpha_D + \varepsilon_{Dj} \quad \text{for } j = 1,2$$

where D represents the day. The estimator of σ^2, the within day variability is then given by:

$$\hat{\sigma}^2 = \frac{(E_{D1} - E_{D2})^2}{2} \tag{6}$$

Of course, if an extra day of testing with two PCB trains is undertaken, more efficient estimators of average efficiency (estimator $\hat{\mu}_E$ of (2)) and among day effects ($\hat{\alpha}_1$ of (3)) are obtainable employing the values E_{D1} and E_{D2}.

FUEL SAMPLING

Fuel samples will also be obtained and analyzed for PCBs, dibenzofurans, dioxins by GCA and the following classic parameters: N, S, Cl, C, H, ash, water, sediment, calorific value, carbon residue and flash point by GM. The fuel samples will consist of:

- A trickle sample obtained during each run
- A sample of the concentrated (~500 ppm) PCB contaminated waste oil.

The waste oil sample will be taken by GM personnel in a container provided by GCA and analyzed for PCB, dibenzofurans and dioxins concentrations before the actual test if the sample is provided at least 2 weeks prior to the test.

The trickle fuel samples will be analyzed for these organics along with other samples taken during the test.

AMBIENT MONITORING

Network Design

The monitoring network has been designed to measure PCB concentrations in the ambient air as it enters plant property, and ambient concentrations in the nearest populated area expected to lie downwind from Stack 3 during the test burns. Meteorological conditions on the date of burn will be used to position the monitors in areas on the plant property where maximum impact from the stack effluent is predicted. In this way, it is hoped to determine background levels, population exposure, and any increases in concentration due to the test burn. Figure A-8 shows the location of the powerhouse with respect to nearby plant facilities. Figure A-9 shows the locations of neighboring populated areas. An example of appropriate placement of monitors during a period of westerly winds is given in these figures. PCB monitors are indicated by the letter M. A continuously recording wind system will measure local wind speed and wind direction at the stack.

Field Procedures for Monitor Placement

Wind directions expected to prevail during the 4-day test period will be used to select an upwind background site and a nearby downwind populated area site. Once the populated area site has been selected and arrangements have been made for the operation of the monitor, no within-day change in the location of this monitor is planned. Also, no change will be made in the location of the background monitor unless a major shift in wind direction indicates that it is clearly unsuitable for background measurements. This monitor will be located in a well-exposed area on plant property, however, and can be moved if circumstances so dictate.

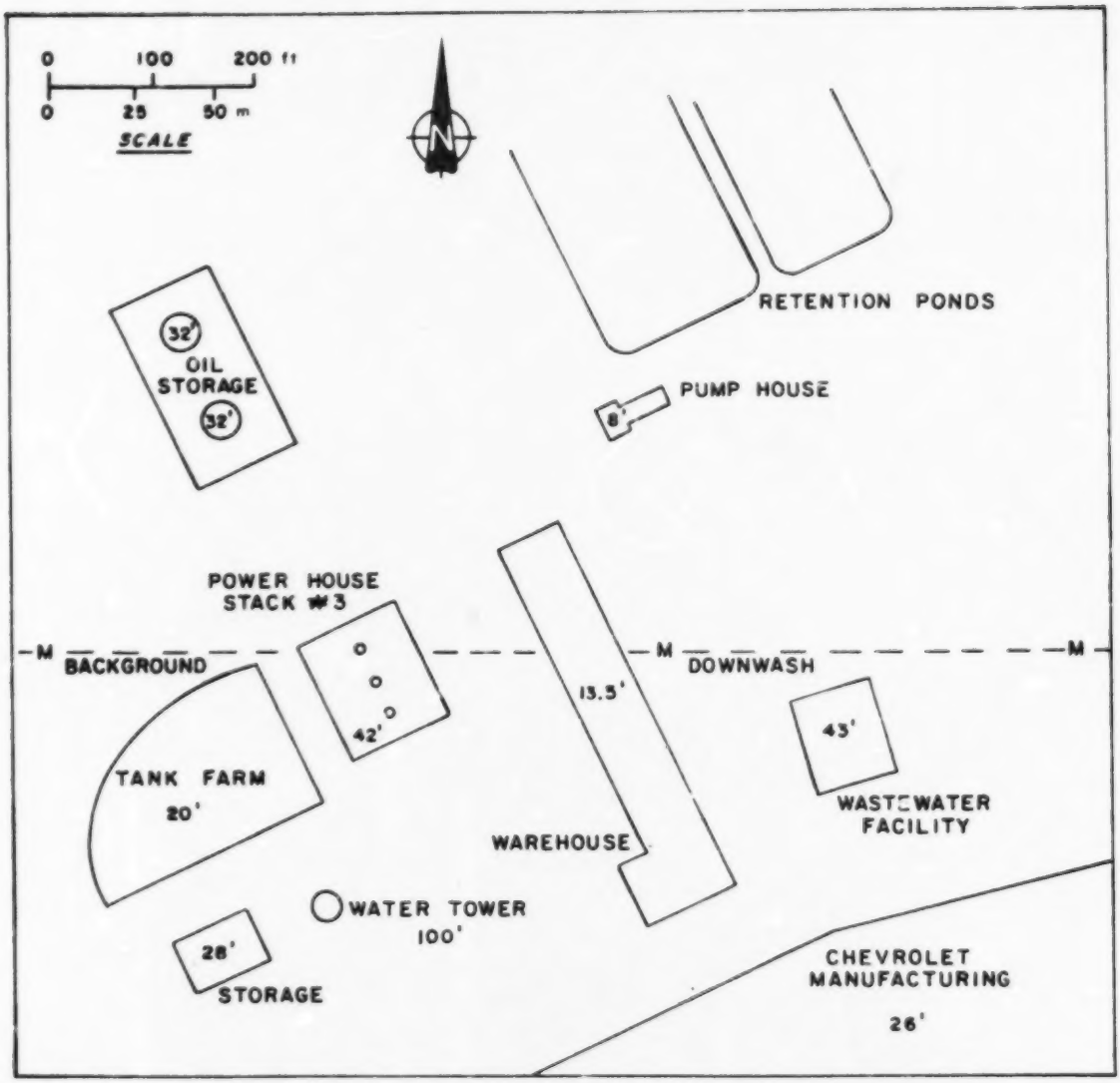


Figure A-8. Plot plan of plant facilities. Structure heights are indicated in feet.

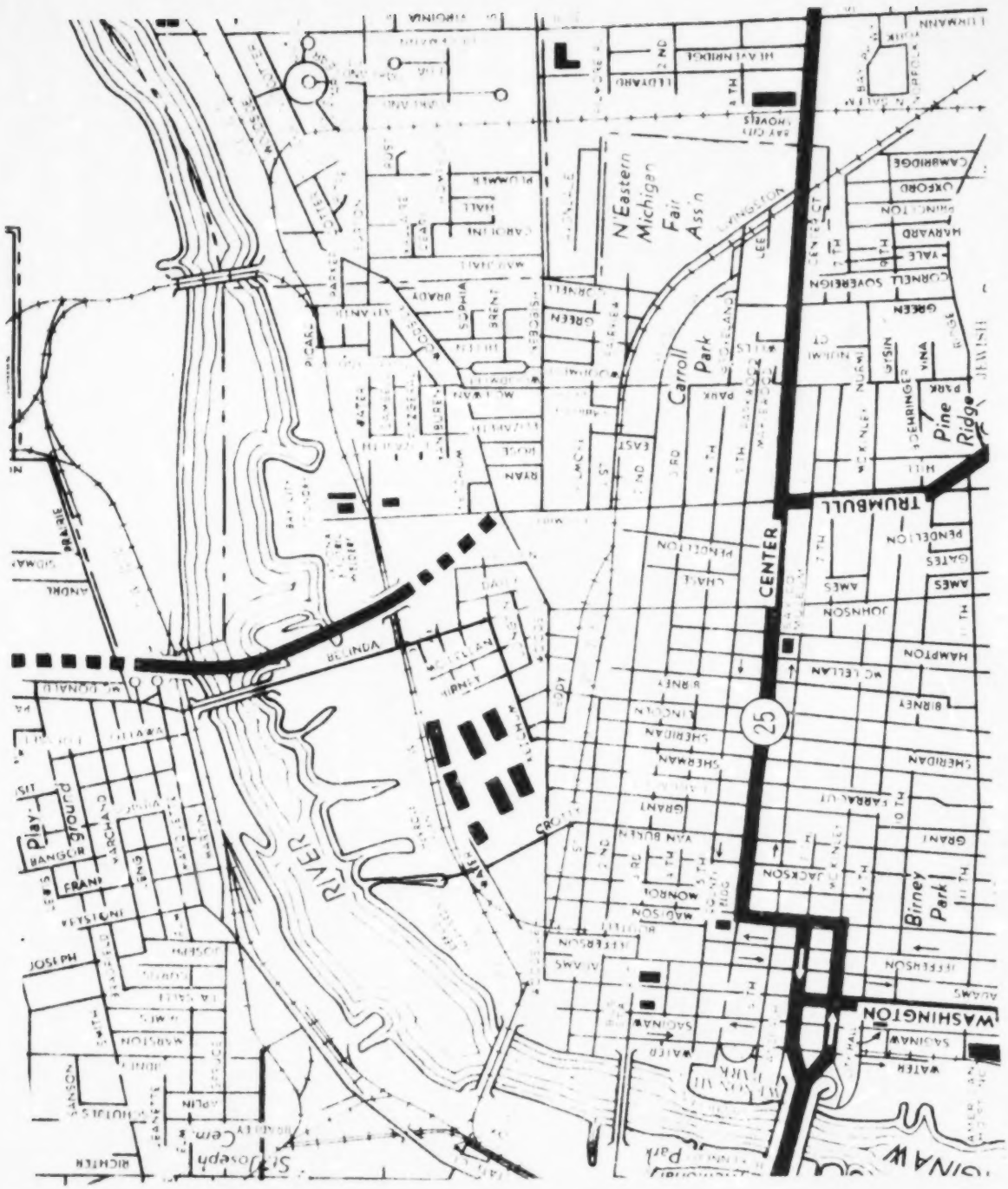


Figure A-9. Sketch of GM facilities and surrounding area.

Positioning of the two on-site downwind monitors will be done each morning prior to the start of the first 3-hour sampling period. This will be done on the basis of forecast weather, on-site wind conditions, and expected plume dispersal. Table A-6 will be used with forecast meteorological conditions to estimate stability conditions throughout the day's test period. Figure A-10 will then be used to determine a distance from the stack at which a monitor is likely to be impacted by the effluent under the predicted stability conditions. The goal will be to select a compromise distance suitable for all expected stabilities during the 6-hour burn period and thus avoid having to reposition monitors during the test burn, rather than attempting to locate the monitors in the area of maximum impact during each individual 3-hour sampling period. After establishing an expected mean downwind direction, plume width information, such as that provided in Figure A-11, will be used in conjunction with Figure A-10 to locate the two monitors. The curves shown in Figures A-10 and A-11 have been calculated for 3-hour release times. Consideration will also be given to any anticipated hotspots from plume downwash if a trajectory directly over a nearby building is predicted. In addition to these theoretical considerations, the actual placement of monitors may be constrained by the physical characteristics of the plant property (e.g., site accessibility and seasonal condition). In the event of an obvious misjudgment in the selection of the two monitors, adjustments in their locations will be made during the test period.

TABLE A-6. KEY TO STABILITY CATEGORIES

Surface wind speed (at 10 m) m sec^{-1}	Day			Night	
	Incoming solar radiation			Thinly overcast or $\geq$ 4/8 low cloud	$\leq$ 3/8 Cloud
	Strong	Moderate	Slight		
< 2	A	A-B	B		
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
> 6	C	D	D	D	D

The neutral class, D, should be assumed for overcast conditions during day or night.

Sampling Method and Schedule

Sampling will be with high-volume samplers, modified as described in "A Method for Sampling and Analysis of Polychlorinated Biphenyls (PCBs) in Ambient Air," EPA-600/4-78-048. The airborne PCB is collected on a series of two precleaned polyurethane foam plugs housed in the sampler throat, a 16-cm long threaded, aluminum tube. Motor exhaust is diverted from the sampler intake by a duct. Flow rate through the sampler will be maintained at between 20 and 35 ft^3/min for a 3-hour sampling period.

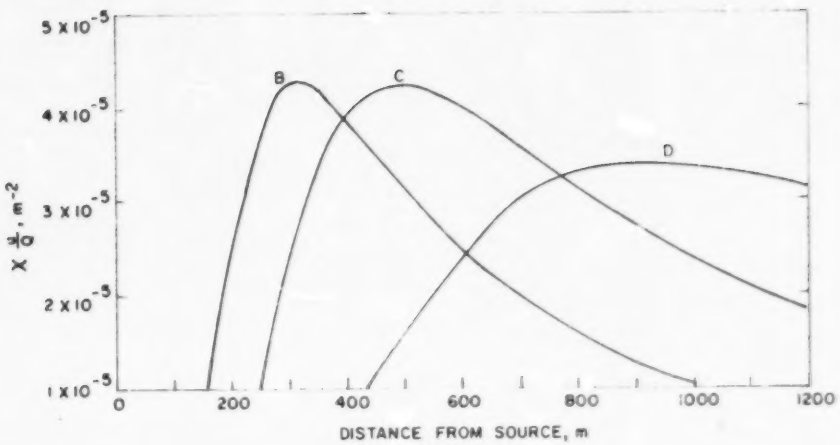


Figure A-10. Normalized concentration as a function of distance from stack for three stability conditions.

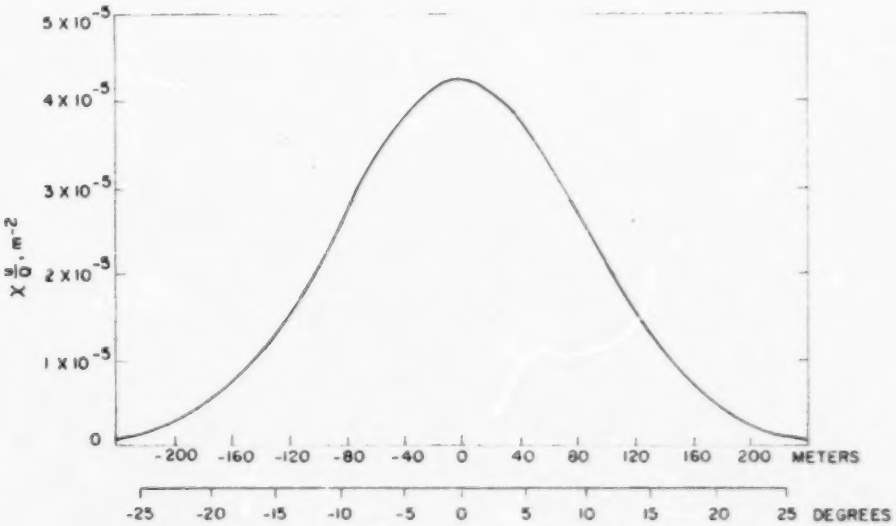


Figure A-11. Normalized concentration as a function of crosswind distance and angular bearing for C stability. Distance from stack is 480 meters.

Ambient sampling will occur on the same days as stack sampling; i.e., 1 day of background burn (No. 6 fuel oil only) followed by 3 days of 10 percent waste fuel burn. Monitors will operate for 12 hours each test day, resulting in four 3-hour samples per monitor per day. This schedule is arranged to provide one pre-burn and one post-burn sample. Additionally, the 6-hour burn period sample will be collected during two 3-hour intervals. The polyurethane foam plugs from the latter will be combined for analysis as one sample. Each day's upwind, background and downwind population samples will be a combination of the four 3-hour samples. This combination scheme and the resulting number of samples to be analyzed from each monitor is illustrated in Figure A-12. Transition from sampling in each period will be expedited in the field by the use of two ambient monitors at each location with timed tandem switching. This procedure will also aid correlation of ambient samples with wind speed and direction at the time of sampling.

The measurement of field parameters has previously been addressed in the stack sampling section. See Table A-3 for a complete listing.

A tentative test schedule for stack and ambient monitoring was presented in Table A-4.

Sampling Requirements

The sampling program will require an additional field team member besides the four at the stack. GCA will provide generators to operate monitors distant from accessible circuits. Other requirements to be provided by GM include:

- two 20 amp circuits for ambient monitors;
- security of unattended ambient monitors and generators located on GM property;
- primary wind speed and direction monitor (GCA will provide a back-up system for use in the event of primary system malfunction).

Quality Control

In order to prevent any contamination of samples with materials which may interfere with analysis, the highest level of quality control will be observed in all field testing. All solvents and resins will be checked for purity before the sampling program. Appropriate blanks will be included to provide background information. Blank polyurethane foam plugs will be transported to the field to provide a field-biased blank. Sample packing lists will be included for each test with information regarding source lot numbers and preservation/extraction techniques.

	AMBIENT MONITORING →			
	← TEST BURN →			
	PERIOD A	PERIOD B	PERIOD C	PERIOD D
TIME (THEORETICAL)	7 AM – 10 AM		4 PM	7 PM
SAMPLING LOCATION				
UPWIND BACKGROUND	A	B	C	D
DOWNWIND/ON-SITE ①	A	B	C	D
DOWNWIND/ON-SITE ②	A	B	C	D
DOWNWIND/POPULATION	A	B	C	D

SAMPLES FOR ANALYSIS

SAMPLING LOCATION	TEST DAY 1	TEST DAY 2	TEST DAY 3	TEST DAY 4	TOTAL FOR ANALYSIS
UPWIND BACKGROUND	1 (A+B+C+D)	1 (A+B+C+D)	1 (A+B+C+D)	1 (A+B+C+D)	4
DOWNWIND/ON-SITE ①	3 (A,B+C,D)	3 (A,B+C,D)	3 (A,B+C,D)	3 (A,B+C,D)	12
DOWNWIND/ON-SITE ②	3 (A,B+C,D)	3 (A,B+C,D)	3 (A,B+C,D)	3 (A,B+C,D)	12
DOWNWIND POPULATION	1 (A+B+C+D)	1 (A+B+C+D)	1 (A+B+C+D)	1 (A+B+C+D)	4
TOTAL FOR ANALYSIS	8	8	8	8	32

Figure A-12. Ambient sample combination scheme and resulting samples for analysis.

The modified Hi-Vol samplers will be calibrated at GCA before and after the test runs; appropriate field data sheets will be used to record data.

Data Interpretation

At the conclusion of the test program the following ambient samples will have been taken:

- Four background observations upwind from the stack.
- Six on-site observations downwind from the stack during test burns.
- Eighteen on-site observations downwind from the stack during no-burn periods (12 pre-burn and 6 post-burn).
- Three observations from the populated area on test burn days.
- One pre-burn observation from the populated area.

The analysis of the above data will be approached in two ways. First, statistical procedures will be used to determine the significance of any elevated PCB levels that appear to be related to the test burns. Second, simple dispersion calculations will be carried out using the actual meteorological conditions at the site during each test burn and measured PCB emission rates to predict values at the downwind monitors and maximum values. These calculations will be used to identify in-plume samples and to judge the appropriateness of the observations in estimating the impact of the PCB burn on ambient concentrations. A presentation of statistical tests suitable for use in the analysis of the field data follows.

The present test plan calls for the placement of two monitors that are to measure the maximum levels of PCBs. Given the configuration of the plant and its surroundings, it is anticipated that these will be placed close to the building housing the boiler. In the following we assume that these two monitors have been placed optimally and do measure maximum levels. Further, we assume that there is available a third station which measures only background levels. We now present a mathematical model for the PCB levels at these monitors and the statistical power of the statistical test appropriate for detecting if the plant adds significantly to the ambient PCB levels.

Model--

Let Station A be the background station. Its PCB level is given by A and is:

$$A = \mu + \varepsilon \qquad (7)$$

Here, μ is the average background and ϵ is the random error. Let the other two stations be given as B and C with PCB levels:

$$B = \mu + k\mu + \epsilon' + ke' \tag{8}$$

$$C = \mu + k\mu + \epsilon'' + ke'' \tag{9}$$

Here $k \geq 0$ represents the constant showing the increase in PCB (e.g., $k = 1$ would imply average PCB is $\mu + k\mu = 2\mu$ so level of PCB is doubled), ϵ', ϵ'', e' and e'' are random measurement errors. We assume all random errors are independent with mean zero and variance σ^2. Further, we assume the mean levels are equal to the standard deviation σ; i.e.:

$$\mu = \sigma \tag{10}$$

The assumption basically assumes a low background PCB level with variability equal to its average. One final assumption is that the levels of PCB are above the error level of the monitoring measurement instruments.

Statistical Test--

On each day there will be three samples available at each on-site monitor (one obtained during boiler test, one obtained before and one after). An appropriate statistical test for testing the null hypothesis of the equality of PCB levels at the three monitors (i.e., no plant contribution) versus the alternative hypothesis of differences between the background station and the other two stations (i.e., plant adds to PCB levels) is a paired t test. Let A_i, B_i, C_i represent the PCB levels at stations A, B and C for time 1, 2 and 3, then the t statistic of this t test is:

$$t = \frac{\sqrt{3}\,\bar{D}}{S_D} \tag{11}$$

where

$$\bar{D} = \frac{\sum_{i=1}^{3} D_i}{3} \tag{12}$$

and

$$S_D^2 = \frac{\sum_{i=1}^{3} \left(D_i - \bar{D}\right)^2}{2} \tag{13}$$

with

$$D_i = \frac{B_i + C_i}{2} - A_i \tag{14}$$

for $i = 1,2,3$. The power of the test (i.e., probability of rejecting incorrect null hypothesis) depends upon the level of significance and the true

value of k. If we view the t test as a one-sided test with level of significance 0.05, then some estimated maximum power values for various k values are:

k	Estimated maximum power
1	0.20
1.5	0.40
2	0.45
3	0.50
4	0.55
6	0.60

Population Exposure--

To measure the impact of the PCBs from the plant on human population, a fourth monitor will be placed in a nearby population center located downwind. If this is represented by F, a model for its PCB levels can be:

$$F_i = \mu + k\mu + \epsilon''' + k\epsilon''' \tag{15}$$

The assumptions made for (7) to (10) are assumed here also. An appropriate paired t test here is:

$$t = \frac{\sqrt{3}\,\overline{G}}{S_G} \tag{16}$$

where

$$\overline{G} = \frac{\sum_{i=1}^{3} G_i}{3} \tag{17}$$

and

$$S_G^2 = \frac{\sum \left(G_i - \overline{G}\right)^2}{2} \tag{18}$$

with

$$G_i = F_i - A_i \tag{19}$$

Some estimated maximum power values for various k values of model (15) are:

k	Estimated maximum power
1	0.15
1.5	0.20
2	0.30
3	0.35
4	0.37
6	0.39

ANALYTICAL APPROACH

Stack Samples

As addressed earlier, two different sampling trains will be utilized during the stack sampling period. One train is designed to accommodate the PCBs emitted from the source. The second train is designed to collect HCl, dibenzofuran, chlorinated dibenzofurans, dioxins and polynuclear aromatic hydrocarbons in the stack gas.

PCB Train--

As outlined previously, there will be a total of five runs conducted for PCB emissions. These will consist of four samples taken while the PCBs are present in the fuel and a method blank. The blank will be identical to the samples except for the absence of PCB in the fuel being burned. All nonblank trains will be spiked to assess PCB sampling efficiency. Each of these trains will generate three types of samples: (1) a series of water impingers; (2) combined hexane and acetone rinses; and (3) a Florisil cartridge. The following analysis flow scheme is outlined in Figure A-13.

The impinger water will be returned to the lab as one combined sample. The aqueous sample in each case is transferred to a liter separatory funnel. The sample container is rinsed with acetone and hexane which are, in turn, added to the separatory funnel. The sample is extracted with three 100 ml portions of hexane which are then combined. The total volume is transferred to a Kuderna-Danish evaporator and the contents reduced to 5 ml. The extract is then dried via a micro sodium sulfate column to remove residual water. This extract is now ready for combination with the Florisil adsorbent tube extract and the concentrate of the hexane and acetone rinses.

Each of the Florisil adsorbent tubes is to be analyzed separately in the following manner: the entire contents of the adsorbent tube is Soxhlet extracted with a given volume of hexane (200 ml) for at least 4 hours. Upon completion of extraction the apparatus is allowed to cool and the contents transferred to a Kuderna-Danish (K-D) evaporator unit. At this point the impinger water extracts are combined with the contents of the K-D unit. The total volume is reduced to 10 ml and allowed to cool.

The combined extracts are partitioned against concentrated sulfuric acid in a 50 ml separatory funnel. The layers are allowed to separate and the acid layer discarded. Further cleanup is accomplished by shaking the extract with 5 ml of KOH in methanol. Again the layers are separated and the methanol layer discarded.

At this point the sample is ready for quantitative analysis of PCB residue. However, if significant color appears in the extract, further cleanup may be necessary.

As described in Figure A-13, the extract will be aliquotted for each of three quantitative procedures plus a 1 ml reserve for a prescreening by gas chromatography with electron capture detection (GC/ECD) and gas chromatography/mass spectrometry (GC/MS). If results indicate that further cleanup is

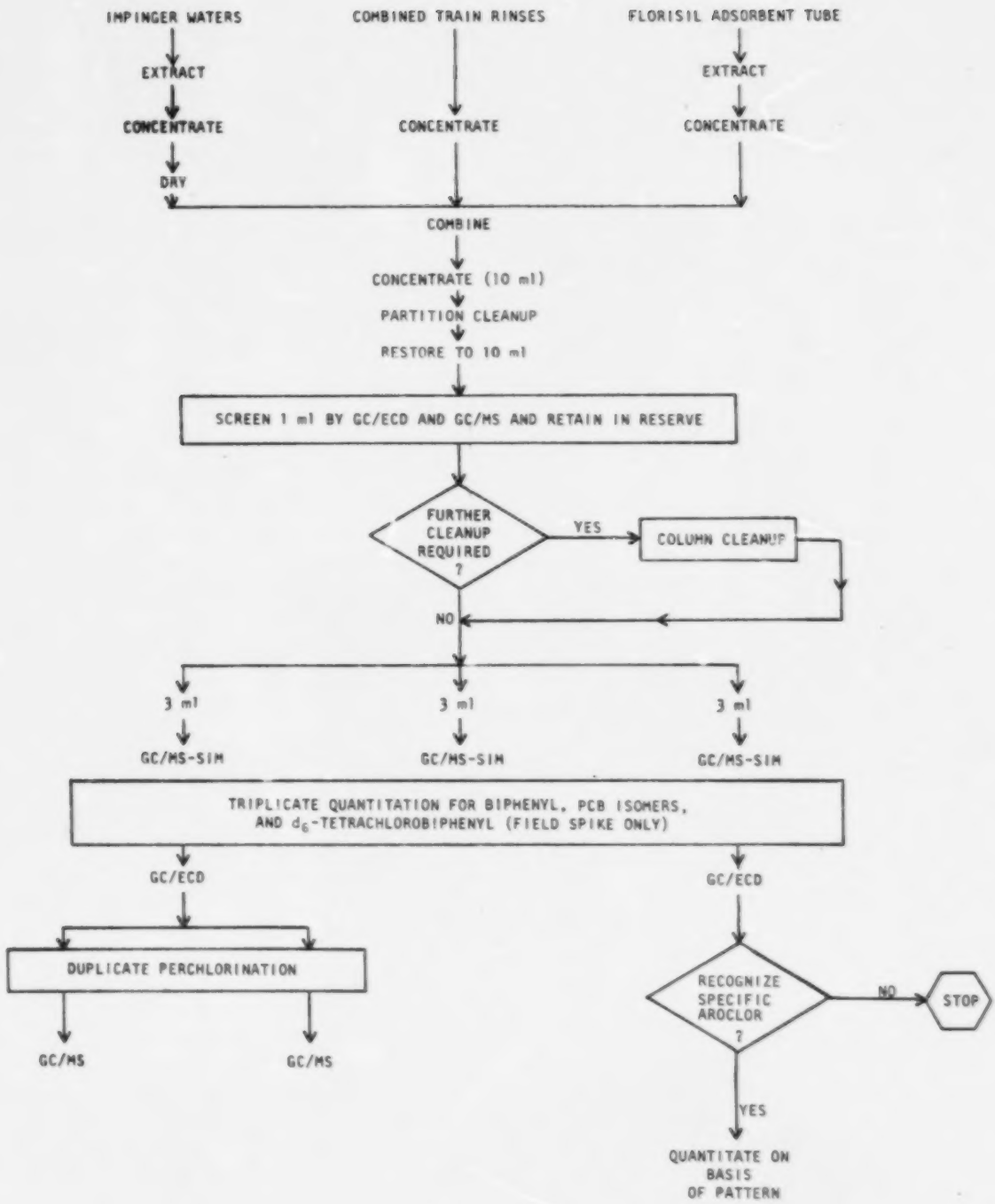


Figure A-13. PCB train: Organic analysis flow scheme.

unwarranted, the remaining 9 ml will be divided into three 3 ml aliquots. To these portions will be added d_{10}-anthracene internal standard for quantitation by GC/MS selected ion monitoring (SIM). The GC/MS quantitative data will be collected on an HP-5985 GC/MS data system.

Data are acquired on a select subset of masses and integrated. Isotopic abundance patterns will be utilized in the qualitative identification of a PCB.

Mass chromatograms will be constructed for each sample based on a single m/e ratio, which is representative of each PCB isomer. Quantitation will be based on responses for pure chlorobiphenyl isomers. A listing of the isomers to be implemented include the following:

- Biphenyl
- 2-Chlorobiphenyl
- 3,3′-Dichlorobiphenyl
- 2,3′,5-Trichlorobiphenyl
- 2,4,5-Trichlorobiphenyl
- 2,3′,4′,5-Tetrachlorobiphenyl
- 2,2′,4,5,5′-Pentachlorobiphenyl
- 2,2,4,4′,6,6′-Hexachlorobiphenyl
- 2,2′,3,3′,4,4′,5,5′,6,6′-Decachlorobiphenyl
- 2,2′,3,4,5,5′,6-Heptachlorobiphenyl
- d_6 - Tetrachlorobiphenyl (field-spike)

As shown in Figure A-13, two of the three aliquots will be analyzed by gas chromatography coupled with an electron capture detector. A Perkin-Elmer 3920 gas chromatograph will be utilized coupled with a Ni^{63} detector. Chromatographic conditions to be employed are outlined in the method for PCBs in Industrial Effluents, Fed. Reg. 38, No. 75, Pt II (1973). Peaks will be recorded and integrated on a 3380S HP data system. Qualitative matching is performed by comparison of the elution pattern with that of a known Aroclor standard. Once the subjective match has been established the sample is quantitated on the basis of instrument response for a known concentration of the matched Aroclor.

After GC/ECD analysis, one of the 3 ml aliquots will be divided into two portions (see Figure A-13). Each portion will be perchlorinated using the modified Mitchell method as described in the EPA document, (EPA-600/4-78-048). The analytical procedure to be employed will be summarized here.

Chloroform is successively added to the hexane extract and azeotrophic evaporation carried out in a microconcentrator apparatus until the sample volume is 1.0 ml. The sample is then transferred to a reaction vial and the

volume reduced to 0.1 ml for perchlorination. A 0.2 ml portion of $SbCl_5$ will be added and the capped reaction vial heated at 160 (±3)°C for 3 hours.

At the conclusion of this reaction period, the vial is air-cooled and finally cooled in an ice bath to 0°C. The residual $SbCl_5$ is neutralized by the addition of 1 ml of 6 N HCl. Subsequent steps include 3 × 1 ml extraction of hexane, followed by a Na_2SO_4 drying procedure. The total hexane volume is eventually reduced to 1 ml prior to quantitation. A GC/MS procedure is used to quantitate the decachlorobiphenyl (DCB) in the sample by comparison of the peak area with that of a known concentration of a DCB standard. Computed DCB values are then converted to approximate equivalent PCB values by utilizing the values summarized in Table A-7. These values will be corrected for any biphenyl or internal standard quantitated by prior GC/MS of the extract.

TABLE A-7. FACTORS TO MATHEMATICALLY CONVERT DECACHLOROBIPHENYL TO AN EQUIVALENT AMOUNT OF AROCLOR

Aroclor	Av. No. Cl[a]	MW[b]	X[c]
1221	1	188.5	0.38
1232	2	223	0.45
1242	3	257.5	0.52
1016	3	257.5	0.52
1248	4	292	0.59
1254	5	326.4	0.65
1260	6	361	0.72
1262	7	395.3	0.79
DCB	10	499	1.00

[a] Average whole number of chlorines calculated from percent chlorine substitution for a specific Aroclor.

[b] Molecular weight of Aroclor based on the average whole number of chlorines calculated from percent chlorine substitution.

[c] X = molecular weight Aroclor/ molecular weight DCB (499). To convert ppm DCB to ppm for a specific Aroclor, multiply ppm × DCB by X for the Aroclor.

In order to provide a real-time estimate of the PCB emissions from the test period, testing days 1 and 2 PCB train samples will be air freighted to GCA's Bedford, Massachusetts laboratory for analysis of PCBs. An aliquot from

the PCB train sample collected on the first day of PCB burn will be analyzed. Blank correction will be accomplished by utilizing an aliquot from the PCB train collected the day before. As illustrated in Figure A-14, the analytical methods for rapid turnaround are an abbreviated method of PCB analysis. PCB quantitation at the GCA laboratory will utilize SIM-GC/MS and GC/ECD without the replicate analyses required by the full analysis flow scheme. The results of the analyses will be used only as a preliminary indication of PCB destruction efficiency. The abbreviated analysis for PCB is still quite lengthy. The complexity of the determination, and the time required for sample transport from Michigan to Massachusetts, may preclude results being obtained much before the end of testing.

Method 5 Particulate Train--

Operated simultaneously with the PCB train, the Method 5 train will provide a total of two runs during PCB burning plus a blank run with No. 6 fuel oil only. Each Method 5 train will produce three types of samples: (1) particulates collected on a filter, (2) XAD adsorbent resin, and (3) impinger condensates. Their respective analytical schemes are shown in Figures A-15 and A-16.

The recovered filters will be returned to the GCA laboratory for particulate analysis as outlined in Figure A-10. Once particulate weights have been recorded, the filter(s) will be aliquotted prior to extraction. The combined filters from each sample run will be soxhlet-extracted for a period of 24 hours in cyclohexane. The resultant extract will undergo a solvent exchange with a mixture of dimethylformamide/H_2O followed by back extraction into cyclohexane. Prior to concentration, each extract is divided into two fractions and dried. Each fraction is concentrated on a rotary evaporator to 0.5 ml. Extracts are spiked with deuterated anthracene and scanned by means of selected ion monitoring GC/MS for: dibenzofuran, 2,8-dichlorodibenzofuran and octachlorodibenzofuran, dioxin, and polynuclear aromatic hydrocarbons (PAH).

The XAD resin utilized will be recovered from the sampling train in the field and returned to the laboratory for subsequent analyses. Each resin sample will be soxhlet-extracted for a period of 24 hours with methylene chloride. The extract will be combined with the probe and filter rinses, concentrated to a working volume of 10 ml and dried. A 3 ml aliquot will be rotary evaporated to 0.5 mol, spiked with deuterated anthracene and analyzed for dibenzofuran. The quantitative procedure will proceed as outlined earlier, by GC/MS with selected ion monitoring. It is believed that the majority of the dibenzofurans will be associated with the particulate matter. The resin extract analysis will be conducted to assess any dibenzofurans, dioxins or PAH not absorbed on the particulates. The 7 ml remainder of the XAD extract will be aliquotted into a 1 ml reserve and two 3 ml portions for assessment of total organic residues (see Figure A-16). This analysis consists of total chromatographable organic (TCO) and gravimetric analyses. A total chromatographable organic analysis is performed providing a simple boiling point distribution of organics between 100° to 300°C. By comparison of sample chromatographic data with that of a standard alkane mixture, distribution of organics in each boiling point region can be assessed.

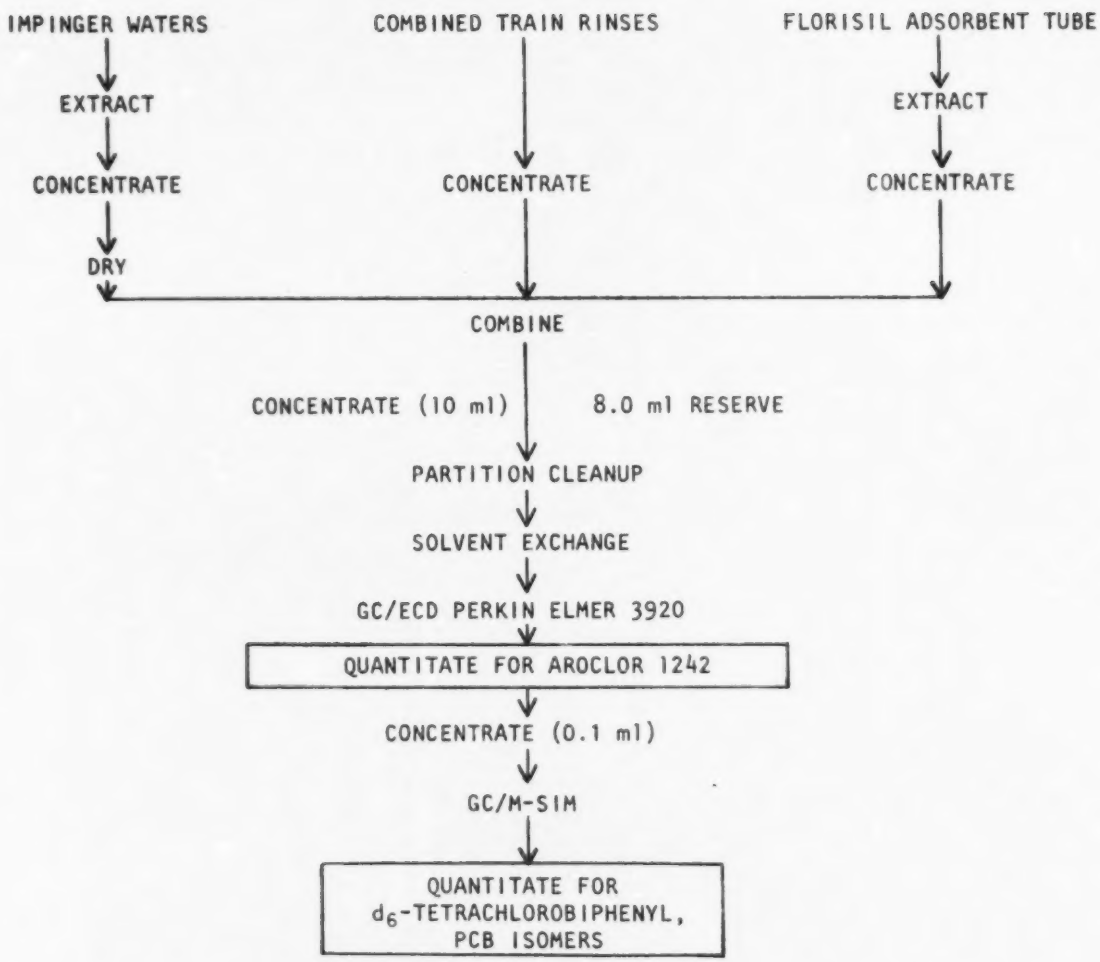


Figure A-14. PCB train: Abbreviated analysis for rapid turnaround.

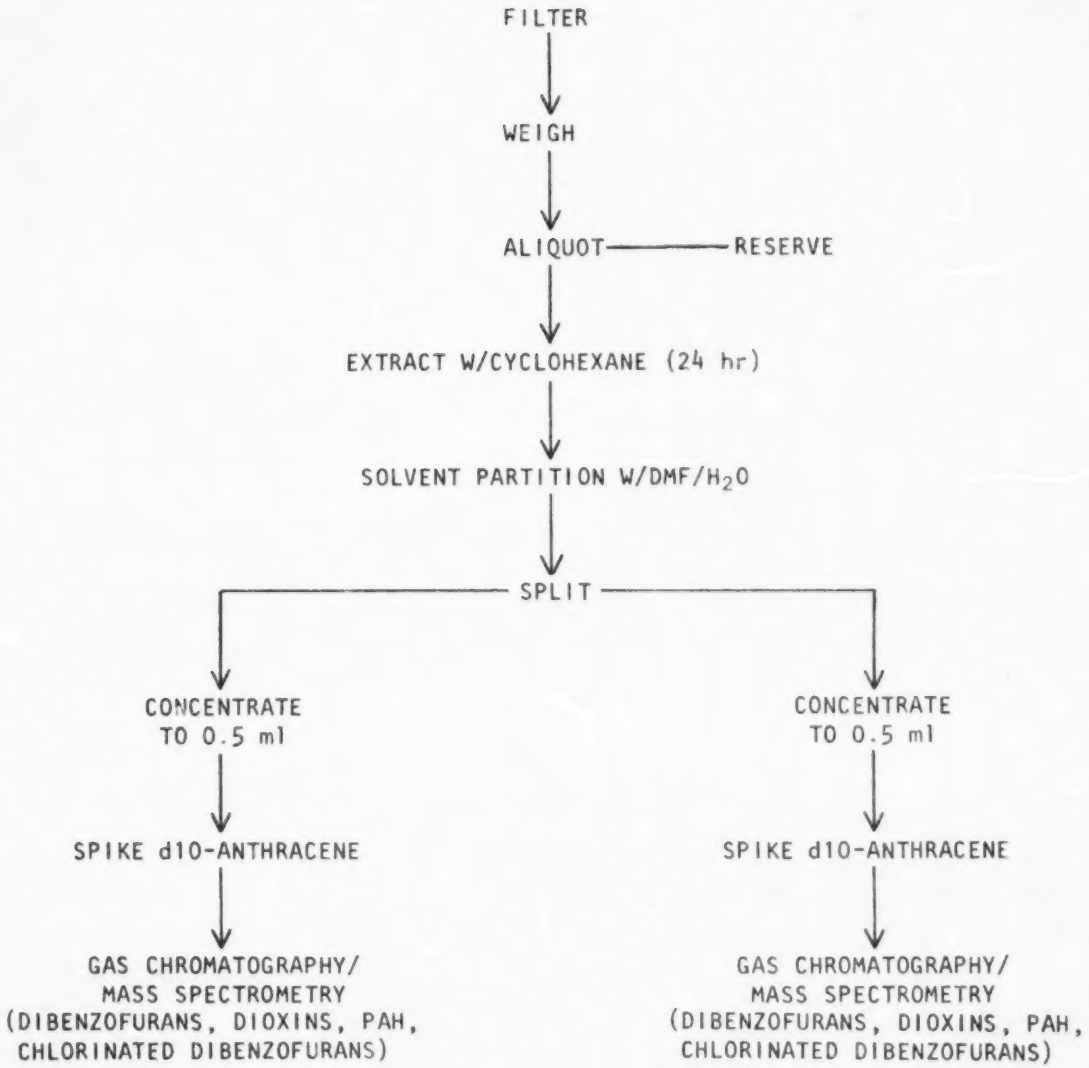


Figure A-15. Method 5 train organic analysis flow scheme: particulate filters.

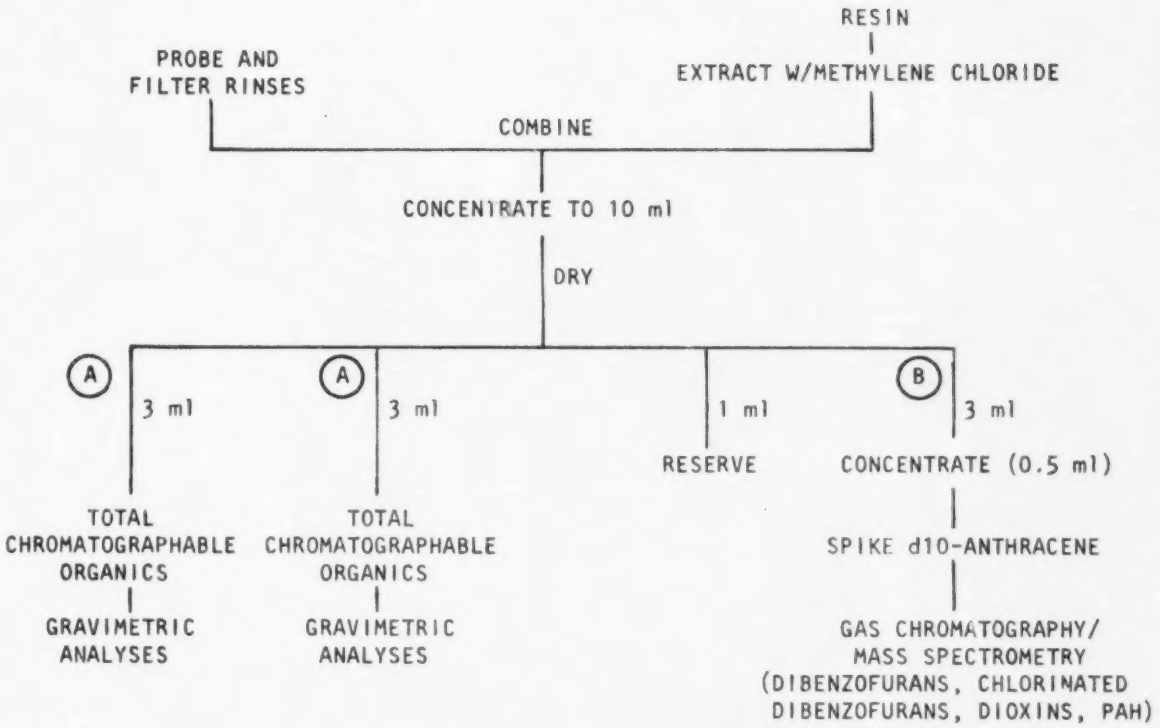


Figure A-16. Method 5 train organic analysis flow scheme: resin.

Quantitative calibration of the TCO procedure is accomplished by use of mixtures of known concentrations of normal hydrocarbons. Analysis is performed on a Tracor 560 gas chromatograph equipped with a flame ionization detector. Data outputs are recorded on an HP 3380S recorder/integrator.

The gravimetric analysis will be used for the quantitation of organic sample components with boiling points higher than 300°C. From each of the 3 ml aliquots discussed earlier, 1 ml is removed and evaporated to dryness in a tared aluminum weighing pan. Evaporation is performed at ambient temperatures and the pan subsequently weighed to a constant weight. The procedure is quite useful in quantitating the nonvolatile organics in sample extracts.

The 20 percent aliquot of the first impinger solution and the combined second and third impinger solutions will be analyzed separately for HCl. The results of the analysis of the first impinger solution will be aliquot corrected and added to the results of the second and third for a total HCl value. The 80 percent extracted aliquot from the first impinger solution will be held in reserve. Analysis for HCl will be accomplished by ion chromatography on a Dionex System 14 Ion Chromatograph. The chloride ion is retained on the separator column (Dionex No. 030065). Sodium bicarbonate is used to elute the chloride ion from the separator column. The second column (Dionex No. 030064) through which the eluant passes removes interfering ions before detection. Quantitation is achieved by comparison of peak response from the unknowns to peak responses obtained for a standard calibration curve.

Fuel Samples

As previously mentioned, fuel samples will consist of one mixed waste fuel grab sample (pretest) and four time-integrated trickle samples from the fuel feed during testing. The samples will be returned to the GCA laboratory and aliquotted for analysis of PCB, dioxins, dibenzofurans and chlorinated dibenzofurans (see Figure A-17). The PCB analysis scheme is comparable to that for stack samples with the exception that the GC/ECD pattern matching step is eliminated. This step is only necessary when selective enhancement of one or more PCB isomers from a mixture is expected to occur, such as in stack sampling.

Ambient Samples

Polyurethane foam plugs will be collected from ambient monitors and returned to the laboratory in precleaned amber glass jars with Teflon-lined caps. The samples will be Soxhlet extracted for 3 hours with hexane. After cooling, the extracts will be transferred to a Kuderna-Danish (K-D) evaporative concentrator and the volume reduced to 5 ml. The extract will then be divided into a reserve plus a portion for duplicate GC/ECD analysis of PCB. Quantitation of PCB will be performed on the basis of aroclar pattern-matching if

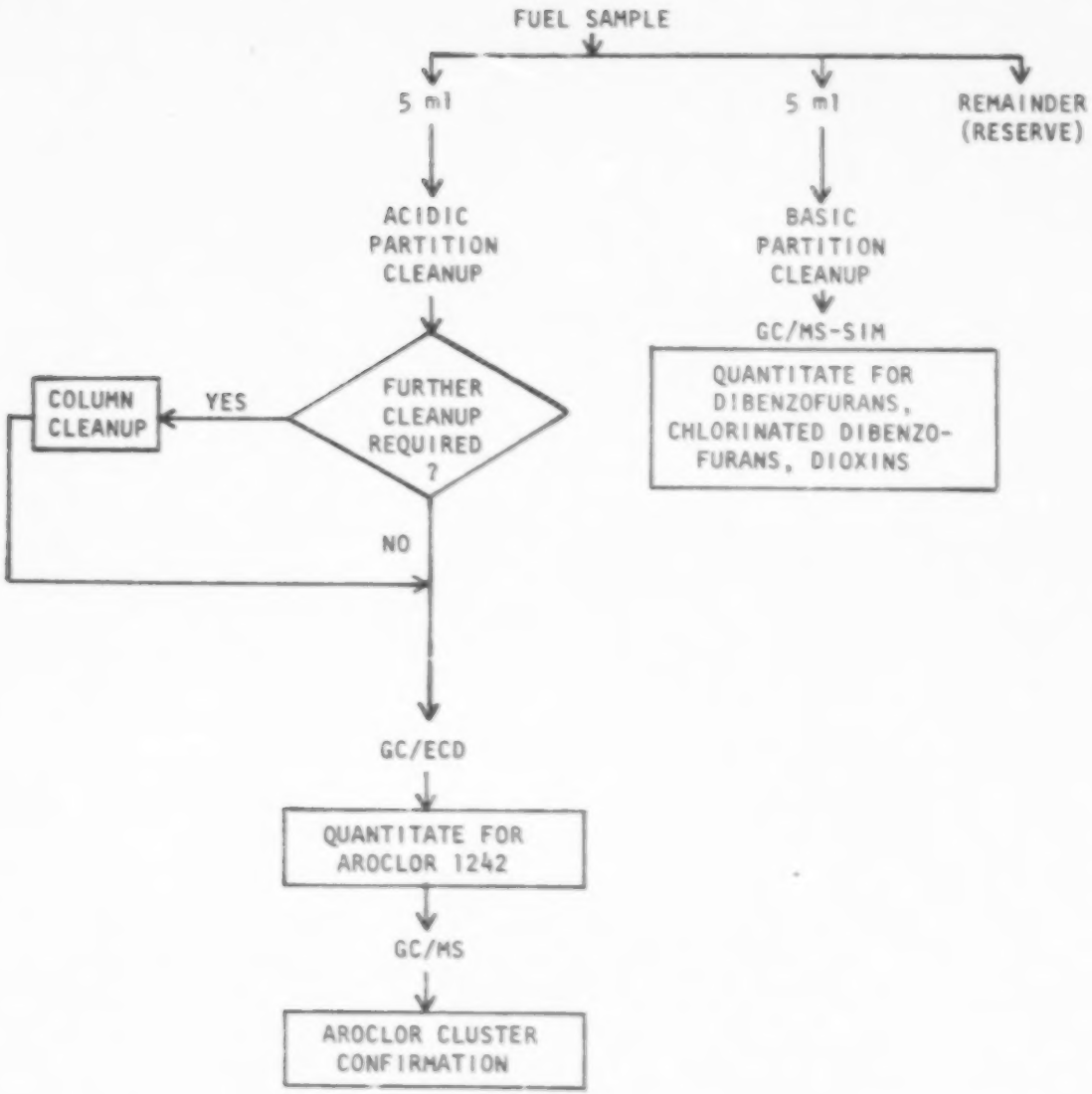


Figure A-17. Fuel samples: Organic analysis flow scheme.

possible or by individual PCB isomers if no pattern is evident. Because the expected ambient levels will not provide sufficient sample for GC/MS analysis, no comfirmation is presently planned.

Quality Control

All reagents, solvents and adsorbents will be subjected to rigorous quality control testing prior to use.

Each matrix for PCB quantitation requires a separate verification of PCB extraction efficiency. In order to accomplish this, GCA/Technology Laboratory Analysis Department will analyze three samples each of Florisil 30/60 mesh, No. 6 fuel oil (PCB waste diluent) and polyurethane foam. Two samples of each type will be spiked with Aroclor 1242 at a level three times the expected detection limit. The other sample will be a blank. Each of the samples will follow the field-generated sample analysis flow scheme with the averaged results being a measure of blank-corrected extraction efficiency.

Quality Assurance

The Division QA Manager has reviewed this test plan and will continue to interact with key technical personnel throughout the program. Specific QC measures for sampling and analysis procedures are included in the test plan sections describing those activities; the QA Manager will audit to assure that the sampling and analysis teams are provided with written operating procedures which include these QC measures in appropriate detail. EPA's and GCA's QA/QC Manuals[23-26] and procedures will be utilized.

One of GCA's statisticians, Ralph D'Agostino, has prepared the statistical evaluation included herein which demonstrates that, given optimally placed monitors and PCB levels which are above the error level of the sampling and analysis techniques, statistically valid decision rules may be used to establish if the burner destruction efficiency equals 99.9 percent of the PCB concentration. The appropriate statistical analyses to use in judging whether the PCB emissions from the plant during the test burn are significantly different from the background PCB levels both on the plant site and at the nearest populated area downwind of the test burn stack are also specified. Dr. D'Agostino will review the actual statistical analyses performed.

GCA field teams are experienced in general ambient and stack sampling as well as PCB sampling and in the use of continuous monitoring instrumentation. Field/laboratory meetings have been held by appropriate staff members to determine and schedule the necessary equipment and reagent preparation. The QA Manager will attend the last of these coordination meetings to assure that the preparation for the sampling trip and later analysis is adequate.

The analysis scheme includes the use of confirmatory procedures which are especially important in the identification of PCBs.[24] A prescreening GC/ECD run on each sample extract will assure that sufficient sample cleanup

has been achieved. GC/MS with selected ion monitoring will then be performed on extract aliquots to utilize the qualitative and quantitative sensitivity of this technique. GC/ECD following the Aroclor pattern matching technique and the perchlorination procedure followed by GC/ECD analysis will be performed on the submitted stack samples for confirmation purposes. The perchlorination provides an independent measurement of a derivative formed by chemical reaction; the use of all three procedures should provide the best PCB identification and quantitation reasonably attainable.

The analysis sections of this test plan include the specific QC procedures to be followed in analyzing for each of the required components. The laboratory staff has considerable experience in handling these complex preparatory and analytical procedures and the laboratory QC Committee inserts appropriate QC checks, and validates data as the samples proceed through the analysis scheme. In all cases, an aliquot of sample extract is reserved for use if needed to check questionable results.

The interpretation of analytical data will be performed and reviewed by chemists experienced in working with complex organic compounds such as those expected to be found in this project. The data interpretation will benefit both from their experience and from the laboratory's ongoing QC program. The QA Manager will participate in the final review meeting before the analytical report is issued.

ENVIRONMENTAL ANALYSIS ASSESSMENT

AMBIENT PCB CONCENTRATION ESTIMATES

In the prediction of the maximum concentration of a sensitive pollutant, it is common practice to model the "worst case" conditions that could occur as well as the most probable conditions. This worst case approach involves using the maximum pollutant concentration possible and assumes the pollutant will be dispersed under the meteorological conditions that are least favorable to its dilution.

Table A-8 displays the pollutant source information used in various phases of the modeling. These data were obtained from plot plans and reports supplied by General Motors Corporation. Two emission conditions were selected for modeling the impact of the proposed test program. First, the emissions were estimated for the absolute worst case of no PCB destruction at all during the combustion process. The second emission condition modeled was that of 99.9 percent destruction (minimum expected) of PCB during combustion.

TABLE A-8. SOURCE PARAMETERS FOR MODEL INPUT

Fuel rate	4 gal/min	
PCB concentration in fuel	50 ppm by weight	
Stack height (above ground)	18.3 meters	
Stack diameter	1.07 meters	
Stack gas temperature	430°K	
Stack gas velocity	7.48 m/s	
PCB emission rate	1. No PCB destruction	0.0107 grams/sec
	2. 99.9% destruction	1.1×10^{-5} grams/sec
Stack gas PCB concentration	1. No PCB destruction	1603 $\mu g/m^3$
	2. 99.9% destruction	1.603 $\mu g/m^3$
Above stack parameters will result in plume rise of 26.1 meters.		
Effective plume height (stack and plume rise) = 44.4 meters.		

While it is difficult to determine the exact atmospheric conditions of wind direction, wind speed, and stability that will result in the maximum concentration for a given source, for elevated point sources, maximum concentrations generally occur with unstable conditions. It is impossible to predict the exact meteorological conditions during the test period but a very

realistic estimate can be made based on historical data. From past data published by the National Weather Service, the wind direction and speed in lower Michigan, during the mid-summer, are southwesterly at 10 mph about 50 percent of the time during the midday hours (the time of strongest instability). Turner[4] states that for wind speeds of 10 mph (4.5 m/s) the stability class most appropriate would be class "B" moderately unstable (this is a valid assumption since stability class "A", extremely unstable, could not exist for the 8 hours of test duration or at wind speeds as high as 10 mph). The meteorologically "worst case" was then chosen as 8 hours of class B instability with southwest winds at 4.5 m/s.

Due to the low stack configuration of the building under test, the modeling was approached from two viewpoints. First, PCB concentrations were predicted for a normal transport of the plume, dispersing it under the worst case meteorological conditions. Both cases of no destruction and 99.9 percent destruction of the PCB were modeled. The second approach was to take that of the plume, due to its low height and ejection speed, being caught in the aerodynamic wake of the building and being dispersed into the small volume directly behind the building as illustrated in Figure A-18. Again, both the no destruction and 99.9 percent destruction cases were analyzed.

PCB concentration estimates for the normal plume approach were based on a steady-state Gaussian plume model developed by Pasquill and Gifford and used by Turner.[4] PCB was assumed to disperse as a gas with no depletion from the plume for this part of the analysis. The plume rise was computed from Briggs[6] and was estimated to be 26.1 meters. This plume rise added to the physical stack height resulted in a final effective plume height of 44.4 meters for a 10 mph (4.5 m/s) wind. The resulting maximum short-term concentration estimates (valid for 1 hour) occurred under stability class "A" with 2 m/s winds. However, this "A" stability condition could not last the 8 hours of test duration so computations of the maximum concentration were made based on class "B" stability also. Then, due to meteorological fluctuations over long time periods, the maximum concentration was reduced by a factor of 0.4985 for the 8-hour test period. Table A-9 presents the short-term maximum and 8-hour mean concentrations for the worst case normal plume dispersion case for both no destruction and 99.9 percent destruction of PCB.

The estimated concentrations for the wake dispersing plume were based on the approach suggested by Smith[5] where the emitted pollutant is dispersed into the volume directly behind the building, producing the maximum concentration of PCB directly behind the building. There are no concentration reductions for long time periods applied here, however, since the plume always disperses into virtually the same volume. The resulting short-term maximum and 8-hour mean concentrations for the no destruction and 99.9 percent destruction cases are presented in Table A-10.

An attempt was then made to estimate the quantity of PCB which may be deposited on the ground due to normal plume depletion mechanisms. To model the worst case, the least horizontally dispersing plume (smallest ground area) was used with the maximum possible depletion rates to yield highest average PCB loading in the smallest ground area. To make the estimate as conservative as possible, it was assumed that the plume path was identical for all three

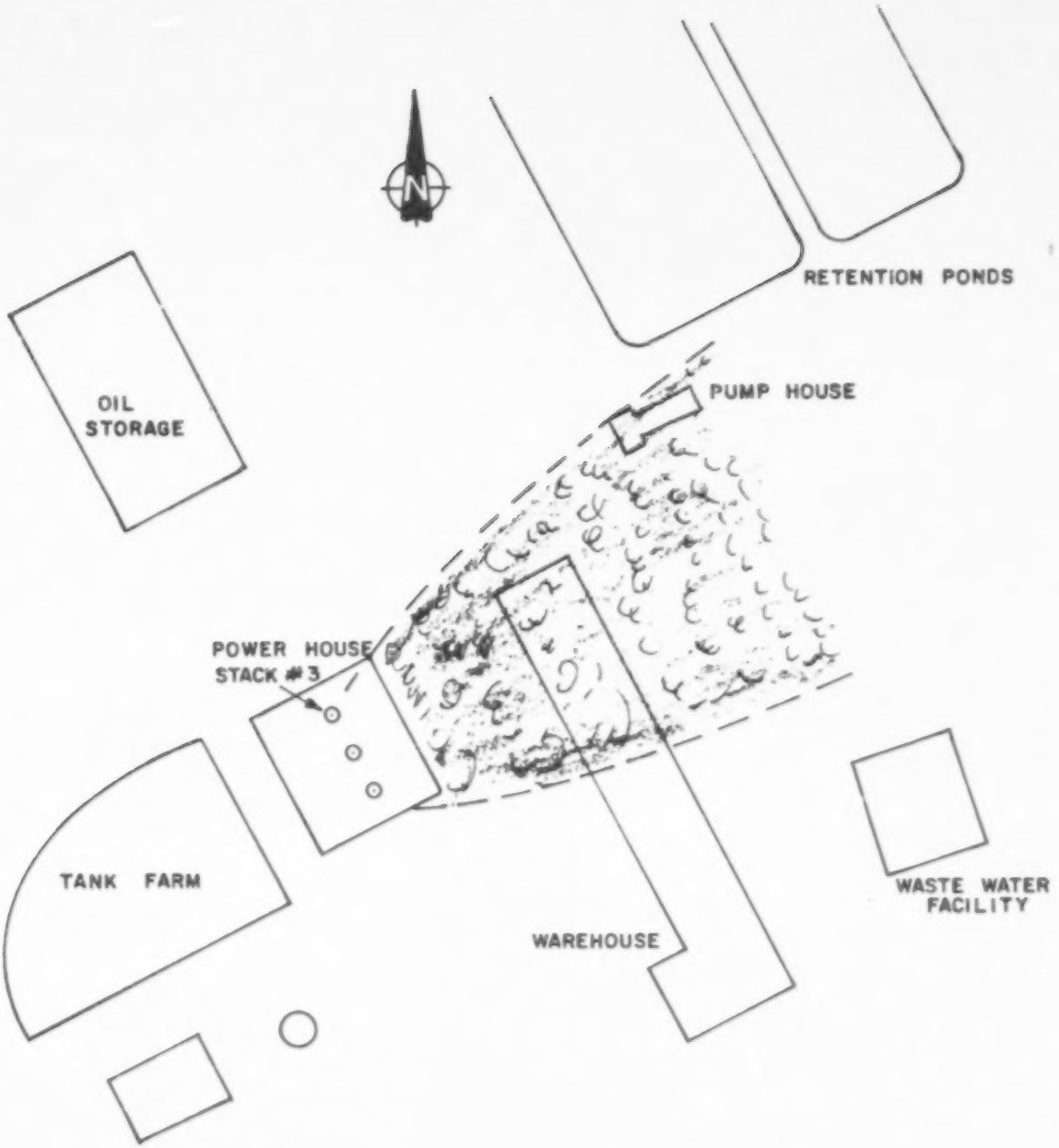


Figure A-18. Dispersal of plume in aerodynamic wake of building.

TABLE A-9. MAXIMUM CONCENTRATIONS WHEN PLUME DISPERSED DOWNWIND - WORST CASE METEOROLOGY

Short-term maximum (1 hr, "A" stability, 2 m/s wind speed). Maximum will occur 225 meters to the northeast of the building.	
No PCB destruction	0.376 $\mu g/m^3$
99.9% destruction	3.8×10^{-4} $\mu g/m^3$
8-hour mean concentration (8-hr, "B" stability, 4.5 m/s wind speed). Maximum will occur 320 meters to the northeast of the building.	
Reduction factor due to 8-hr sampling period = 0.498	
No PCB destruction	0.084 $\mu g/m^3$
99.9% destruction	8.4×10^{-5} $\mu g/m^3$

TABLE A-10. MAXIMUM CONCENTRATIONS WHEN PLUME DISPERSED IN BUILDING WAKE - WORST CASE METEOROLOGY

Short-term maximum (1-hr, "A" stability, 2 m/s wind speed).	
No PCB destruction	9.74 $\mu g/m^3$
99.9% destruction	9.7×10^{-3} $\mu g/m^3$
8-hour mean concentration (8-hr, "B" stability, 4.5 m/s wind speed).	
No PCB destruction	4.36 $\mu g/m^3$
99.9% destruction	4.4×10^{-3} $\mu g/m^3$

8-hour test periods, thus depositing the maximum PCB on the smallest ground area. Only the case of no PCB destruction during combustion was investigated for maximum impact. Figure A-19 presents a graph developed by Murphy[22] of dry gaseous velocities for a variety of ground covers. The equation solved for deposition velocity was:

$$V_g = \frac{1}{V_a + V_b + V_c}$$

where V_a = a momentum transfer term

V_b = a concentration gradient term

V_c = a surface (grcund cover) term

If it is assumed that the ground cover within 100 km is predominantly a combination of grass and oak-hickory forest in summer, for a wind speed of 10 mph (4.5 m/s), the average dry deposition velocity from Figure A-19 is approximately 1.4 cm/s.

Plume depletion fractions were computed by Markee[7] for a plume under varying stability classes with a variety of deposition velocities. The most applicable case, and the one used here, was for a 1.0 cm/s deposition velocity. The results of this analysis are presented in Table A-11.

TABLE A-11. PCB TRANSFER/AREA

	Plume sector (km)	Plume depletion		Sector area ($10^6 m^2$)	Deposition ($\mu g/m^2$)
		%	grams		
	0-1	11	101.7	0.108	946.
	1-5	17	157.2	2.311	68.
	5-10	11	101.7	6.504	16.
	10-50	30	277.35	173.828	1.6
	50-100	10	92.5	462.250	0.20
Total:	0-100	79	730.4	645.000	1.13

Total: Maximum of 924.5 grams emitted during 24 hours of testing - No destruction.

Note that 79 percent of the plume is depleted by the downwind distance of 100 km with 0.85 $\mu g/m^2$ deposition over an area of 645 × $10^6 m^2$. However, by breaking the plume into downwind sectors the realism of the estimation can be increased, since (as seen in Table A-11) more deposition will occur with closer distances to the stack.

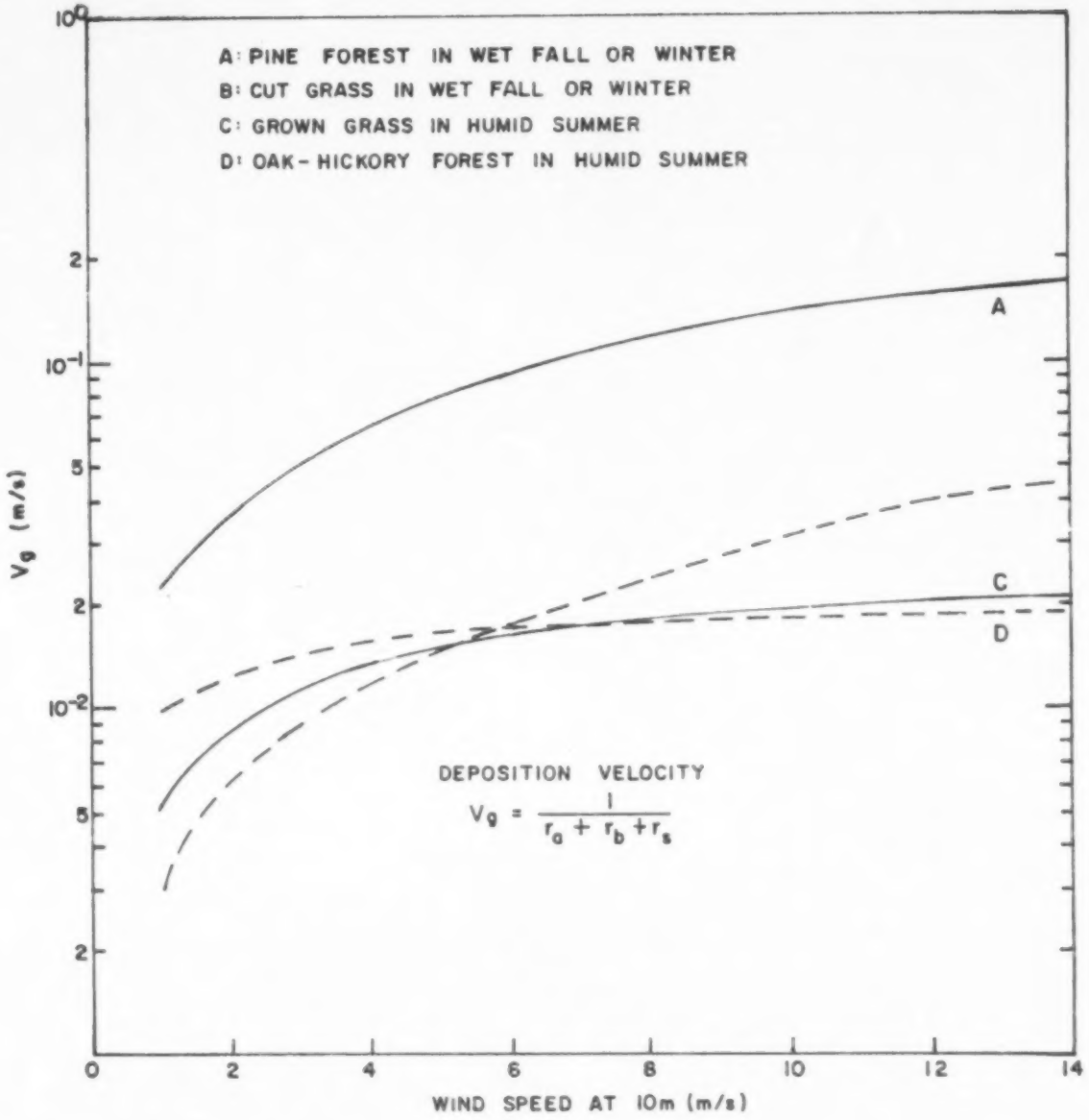

A: PINE FOREST IN WET FALL OR WINTER
B: CUT GRASS IN WET FALL OR WINTER
C: GROWN GRASS IN HUMID SUMMER
D: OAK-HICKORY FOREST IN HUMID SUMMER
A
C
D
DEPOSITION VELOCITY
$V_g = \frac{1}{r_a + r_b + r_s}$
V_g (m/s)
WIND SPEED AT 10m (m/s)

Figure A-19. Deposition velocity versus wind speed.

HEALTH AND ENVIRONMENTAL EFFECTS BASED ON WORST CASE EXPOSURE

PCB concentrations in air to which individuals may be exposed as a result of the test schedule have been calculated for a variety of exposure conditions. A worst case exposure would occur if maximum ground level concentrations are assumed to exist in the area immediately downwind of the point of release. Values calculated are based on the assumption of no PCB destruction as well as 99.9 percent PCB destruction during incineration. The 8-hour mean concentrations of PCBs under these conditions are 4.36 $\mu g/m^3$ (0.32 parts per billion (ppb)) and 4.4×10^{-3} $\mu g/m^3$ (3.2×10^{-4} ppb), respectively (see Table A-9).

The average respiratory volume of air for adults is 30 m^3 for 24 hours.[8] For the 8-hour duration of one test, this translates to 10 m air respired. Based on our estimated worst case concentrations of PCB (4.36 $\mu g/m^3$), an individual would be exposed to a total of 43.6 µg for one test period. Over the 24 hours of the complete test program, this is an exposure to an estimated 130.8 µg PCB.

Potentially adverse health effects due to PCB exposure include both short-term (acute) and long-term (chronic) effects. The chronic toxicity of PCB appears to be of greater significance than does acute toxicity. Acute exposure studies have yielded data which show that LD_{50} values for laboratory mammals exposed to a single dose of PCB range from 2 to 11 g/kg.[9] Human exposures are unlikely to ever reach such levels. As a long-term concern, however, PCBs have been shown to accumulate in body tissues since they are not readily metabolized or excreted. They have been shown to exert toxic effects on the liver, the gastro-intestinal track, and the central nervous system.[10] PCBs have been implicated as human teratogens and some carcinogenic and embryotoxic effects have been noted in laboratory animals receiving large doses for lengthy periods of time.[10]

We have calculated that an individual may be exposed to 130.8 µg PCB (for the entire duration of the test program) under worst case exposure conditions. Potential detrimental health effects for exposure of individuals to this level of PCBs may be evaluated by contrasting this value with the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) for PCBs. TLVs describe levels assumed to be safe based on evidence of both acute and chronic toxic effects to humans, including carcinogenic effects, and on studies of animal toxicity data which describe acute, chronic, and oncogenic responses. TLV concentration levels are time-weighted averages which assume that a worker or other individuals will be continuously exposed to the substance(s) in question 8 hours a day and 40 hours a week, for a normal working lifetime. The ACGIH TLV for PCBs is 37 ppb. Assuming an average respiratory volume, this equates to an 8-hour exposure to a total of 504.1 µg PCB. Direct comparison may be made between this level of PCB and that arising from the test program since they are on an equivalent hourly basis. Total PCBs to which an individual may be exposed based on 8 hours of testing is 43.6 µg, even under worst conditions (assuming no PCB destruction). Based on this comparison, PCB levels arising from the complete test program pose no threat to human health, even assuming worst case exposure.

A limited number of bioassays of PCBs have been performed and additional tests for carcinogenicity and teratogenicity are being conducted. PCBs have produced some carcinogenic responses in rats and mice but the lowest dose resulting in such effects is reported as 1200 mg/kg.[10]

Effects likely to occur from PCB contamination of the environment to plant or animal life may include histological, or other sublethal effects. Aquatic organisms accumulate PCBs from water, dietary sources, and sediment. This cumulative potential of PCBs is of concern in considering toxicity to aquatic life. It has been reported that fish can concentrate 200,000 times more PCBs in their flesh than is present in surrounding water.[13] The indirect toxicity of PCBs to predators through accumulation in tissues of food organisms may cause death from concentrations in water that would not cause a directly lethal effect.

These data have led EPA to propose water quality criteria of 0.001 µg/l (1.0 ppt) PCB for freshwater and marine aquatic life.[14] Also, PCB concentrations in whole fish should not exceed 0.5 mg/kg of the wet weight for protection of fish-eating birds and mammals according to NAS/NAE Water Quality Criteria.[15]

At present, typical values for PCB concentrations in North American freshwaters range from 5-500 or more ppt depending on the industrial effluent or other discharge the waters receive.[10] Values as high as 15,800 ppt have been reported.[10]

The figures in Table A-11 may be used to estimate potential environmental effects of the PCB incineration test program. It is assumed that such environmental effects will be totally dependent upon PCB emissions eventually reaching a freshwater source and exerting an effect on aquatic organisms, and through such organisms to mammalian predators and other species. It is likewise assumed that leaching of PCBs deposited on the soil is the mechanism by which they are transported to the freshwater source. Runoff, direct deposition of particulate matter to which PCBs are adsorbed, or other potential transport mechanisms have not been considered.

As listed in Table A-11, 0-1 km from the point of release, PCB concentrations on the ground level have been calculated to be 946 $\mu g/m^2$ assuming no destruction of PCBs, which is a "worst case" concentration. Values calculated assuming 99.9 percent PCB destruction are 1,000 times less or 946 ng/m^2.

During the summer months, the locale in which the test site is situated receives an average of approximately 3 in. of rainfall per month.[16] This is approximately 76 liters/m^2. Because solubility of PCBs in water is minimal, leaching will not remove 100 percent of the total present in the soil. Tucker et al. percolated water through columns packed with several types of soil coated with Aroclor 1016 and the effluent water was analyzed for PCBs in one laboratory study. As expected, soils with higher clay content retained PCBs more effectively. Even in the worst case, however, less than 0.05 percent of the total Aroclor present was leached from the soil under the test conditions and after 4 months of exposure.[17] In addition, only the less-chlorinated,

more easily degradable isomers were leached. More recent leaching studies involving actual measurements of PCBs after equilibrium conditions were reached in situ have concluded that the total amount of PCBs released from soil due to leaching is approxiamtely 0.2 percent of the total initially present.[17-19]

Taking this latter estimate as worst case leaching and applying it to one model results in a calculated PCB concentration of approximately 26 ppt before dilution by ground-water sources. As mentioned previously, the U.S. Environmental Protection Agency has proposed water quality criteria levels for PCBs in freshwater of 1 ppt.[16] In relating final concentrations of toxic substances in ambient freshwaters to the concentrations released, a dilution on the order of 100,000 or more can be expected. Such dilutions[10,20] would reduce the levels of PCBs from the test program to values well below the EPA water criteria. An undiluted value of 26 ppt is well within the typical background levels now reported for North American freshwaters.[10]

Likewise, it should be reiterated that this concentration (26 ppt) of PCB is based on an absolute worst case model; i.e., no PCB destruction in the stack, maximum deposition of the airborne PCBs on the ground, maximum ground concentration for calculating the amount potentially leached, and maximum leaching due to rainwater. If, as is more likely, 99.9 percent of the PCBs are destroyed during combustion, concentrations of PCBs potentially entering ground water will, even with no further dilution, meet the EPA freshwater criteria.

As Table A-12 summarizes, even under worst possible conditions of no PCB destruction during combustion, the potential environmental and health detriment due to release of PCBs by this test program will be negligible.

A reevaluation of the possible "worst case" air quality impact was performed to ensure that meteorological conditions occurring during the winter would not result in a more severe condition than would occur in the summer.

Historical records published by the National Weather Service indicate that, besides the temperature being much lower, the major difference between summer and winter is the increase in wind speed. The prevailing direction is still from the southwest, but the average speed increases from approximately 3.5 m/s in summer to about 6 m/s in the winter. Winter speeds this great can only result in a "neutral" atmospheric stability condition, especially when coupled with the decrease in sunlight intensity in the winter. In light of this, the summer analyses were performed using winter meteorological conditions.

During the part of the day when testing will occur, the atmosphere, with a 6 m/s wind speed, will be "neutral." However, for short-term "worst case" maximum concentrations, a "slightly unstable" condition will be "forced" to provide an extra measure of conservatism to the estimates. Therefore, short-term concentrations will be based on 1 hour of "C" (slightly unstable) stability and long-term mean concentrations, based on 10 hours of "D" neutral stability.

TABLE A-12. COMPARISON OF HEALTH AND ECOLOGICAL PCB STANDARDS TO PCB LEVELS RESULTING FROM WORST CASE HUMAN AND ENVIRONMENTAL EXPOSURE[a]

	From air inspiration (µg)	In water (ng/l)
Total human exposure	130.8	-
Workplace standard[b]	1512.3	-
Potential ground-water level[c]	-	0.00026
Proposed EPA level	-	1.0[13]
Typical North American freshwater levels	-	5-500[9]

[a]Worst case exposures based on three 8-hour periods of PCB trial destruction.

[b]ACGIH TLV which is the maximum level considered safe for 8-hour/day, 5-day/week continuous exposure.

[c]Assuming 3 in. rain, 946 µg/m^2 deposition in the 0-1 km sector and a minimum of 100,000 dilution factor after PCBs reach ground water.

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Tables A-13 and A-14 list the maximum concentrations that may be expected during the winter season for the normal plume transport case, and the case of the plume dispersing into the volume immediately behind the building, respectively.

Using the approach described in the previous (summer) analysis, the PCB deposition per unit area of ground was computed for a "neutral" plume. These deposition notes are presented in Table A-15. Note that the resulting winter deposition will be much smaller than the estimates for the summer.

Table A-16 presents the hourly average ground level ambient concentrations during the conditions that will produce the deposition reported in Table A-15.

The concentration resulting from a 2-minute release of PCB was determined for 1 hour and 10 hours. Assuming the 2-minute release occurred at the start of the 1 hour of "C" stability and was followed by 9 hours of "D" stability, the 1-hour concentration immediately downwind of the building would be 0.22 $\mu g/m^3$ and the 10-hour average would be 0.081 $\mu g/m^3$.

TABLE A-13. MAXIMUM CONCENTRATIONS WHEN PLUME DISPERSED DOWNWIND - WINTER METEOROLOGY

A. Short-term maximum will occur 420 m downwind to the northeast of the building

1 hour, "C" stability, 6 m/s wind speed

No PCB destruction	0.16 $\mu g/m^3$
9.99% destruction	1.6×10^{-4} $\mu g/m^3$

B. 10-hour mean concentration will occur 780 m downwind to the northeast of the building

10 hours, "D" stability, 6 m/s wind speed

Reduction factor due to 10 hour sampling periond = 0.63

No PCB destruction	0.048 $\mu g/m^3$
99.9% PCB destruction	4.8×10^{-5} $\mu g/m^3$

TABLE A-14. MAXIMUM CONCENTRATIONS WHEN PLUME DISPERSED INTO BUILDING WAKE - WINTER METEOROLOGY

Short-term maximum (1-hour, "C" stability, 6 m/s wind speed)

No PCB destruction	3.24 $\mu g/m^3$
99.9% destruction	3.24×10^{-3} $\mu g/m^3$

10-hour measurement concentration will be the same.

TABLE A-15. PCB DEPOSITION/AREA (WINTER)

	Plume sector (km)	Plume depletion		Sector area ($10^6 m^2$)	Deposition ($\mu g/m^2$)
		%	grams		
	0 - 0.25	4.	37.0	0.0102	3627.
	0.25 - 0.50	2.	18.5	0.0274	675.
	0.50 - 0.75	1.5	13.9	0.0462	301.
	0.75 - 1.0	1.5	13.9	0.0666	209.
	1.0 - 5.0	11.	101.7	3.075	33.1
	5.0 - 10.0	5.	46.2	8.600	5.37
	10.0 - 50.0	14.	129.4	224.675	0.576
	50.0 - 100	8.	73.9	623.500	0.119
Total	0 - 100	47	434.5	860.000	0.505

TABLE A-16. SHORT-TERM PCB GROUND LEVEL CONCENTRATIONS AT PLUME SECTOR CUTOFFS (WINTER)

Downwind distance (m)	PCB concentration no destruction ($\mu g/m^3$)	PCB concentration 99.9% destruction ($\mu g/m^3$)
250	0.49	4.9×10^{-4}
500	0.34	3.4×10^{-4}
750	0.23	2.3×10^{-4}
1000	0.18	1.8×10^{-4}
5000	0.021	2.1×10^{-5}
10000	0.0082	8.2×10^{-6}
50000	0.00058	8.8×10^{-7}
100000	0.00033	3.3×10^{-7}

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16. ABSTRACT The two-volume report documents the permitting process followed by the State of Michigan before allowing a trial destruction burn of polychlorinated biphenals (PCBs) at the General Motors (GM) Chevrolet Bay City plant. Volume I includes a chronology of events and a matrix depicting the interaction of federal, state, and local government agencies and GM in the permitting process. The matrix presents a list of who requested and who responded to each need for additional information. An analysis of the significance of interactions, including interagency communications, private sector/public communication, and the flow and quality of information develded is provided. Finally, recommendations that are based on this permit application process and that might facilitate subsequent applications for burns of hazardous materials are made. Volume II contains the relevant documents summarized in the Volume I lists. Recommendations include: (1) identification of all groups that may play an important role in future permitting processes; (2) contacting these groups by letter or in person; (3) developing a relationship of cooperation with these groups; (4) determining the level of support for proposed action; and (5) determining the necessary course of action based on the level of support.

17. KEY WORDS AND DOCUMENT ANALYSIS				
a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group	
Pollution	Incinerators	Pollution Control	13B	
Chlorine Aromatic Compounds	Waste Disposal	Stationary Sources		
Biphenyl	Boilers	Polychlorinated Biphenyls (PCBs)	07C	13A
Insulating Oil	Licenses			05D
Combustion	Toxicity	Permitting Process	11H	06T
	Communicating	Waste Oil	21B	15E

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